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WATER REUSE AND ENVIRONMENTAL CONSERVATION PROJECT

CONTRACT NO. EDH–I–00–08–00024–00 ORDER NO. 04

WADI MOUSA SOCIOECONOMIC IMPACT ANALYSIS

July 2015

IMPLEMENTED BY AECOM

WATER REUSE AND ENVIRONMENTAL
CONSERVATION PROJECT
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Submitted to:

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AECOM

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LIST OF ACRONYMS

AWC	Aqaba Water Company
BRDP	Badia Research and Development Program
GIR	Gross Irrigation Requirements
GoJ	Government of Jordan
HFDB	Hashemite Fund for Development of Jordan Badia
JCC	Jordanian Cooperative Corporation
JD	Jordanian dinar
ME	Man equivalent
MOA	Ministry of Agriculture
MoPIC	Ministry of Planning and International Cooperation
MOU	Memorandum of Understanding
NCARE	National Center for Agricultural Research
PRA	Petra Regional Authority
RIAL	Reuse for Industry, Agriculture and Landscaping
WAJ	Water Authority of Jordan
WRECP	Water Reuse and Environmental Conservation Project
WRIP	Water Reuse Implementation Project
WUA	Water Users' Association
WWTP	Wastewater treatment plant

1 Introduction

The USAID Water Reuse and Environmental Conservation Project (the project, or WRECP) works throughout Jordan in institutional capacity building, pollution prevention for industry, solid waste and wastewater management, biosolids management, and water reuse. The project goal is to protect and conserve scarce resources through regulation, education, and coordination with industry, local communities and the private sector. The project is implemented by AECOM and a team of international and Jordanian partner firms. This five-year project has four primary tasks:

Task 1 – Institutional and Regulatory Strengthening
Task 2 – Pollution Prevention and Industrial Water Management
Task 3 – Disposal Sites Rehabilitation and Feasibility Studies
Task 4 – Water Reuse for Community Livelihood Enhancement, including Biosolids Management

The Task "Water Reuse for Community Livelihood Enhancement" focuses on promoting the beneficial reuse of treated wastewater from USAID-funded wastewater treatment plants. The subject of this report is a Water Reuse Pilot Project focused on the beneficial reuse of treated effluent to contribute to economic growth and sustainability in Wadi Musa Jordan. As described in this report, the pilot has been successful in many ways, and ,because of that success it is being used as a model and is being replicated in other areas of the Kingdom. The Water Authority of Jordan requested project assistance in replicating the Wadi Mousa success at Za'atari refugee camp and Azraq.

1.1 Water Scarcity Background

Water scarcity is one of the most important natural resource constraints on Jordan's economic growth. High population growth, increasing urban and industrial demands for water, and other factors such as population increase, refugee influx, improvement of living standards, industrialization and tourism, have placed unprecedented demands on the fresh water resources. This situation has been worsened by the continuous depletion of Jordan's fresh water supply at an alarming rate. Available water supply is less than that needed to meet current and projected demand.

According to Jordan's Water Strategy (2009), the country's annual per capita water availability is less than 150 m^3 per year. By 2025, the available per capita per year is projected to decline to 90 m^3 per capita per year, putting Jordan in the category of an absolute water shortage (El-Nasser, 2009).

Approximately 70% of fresh water in Jordan is used in non-potable applications; the major consumer of fresh water is the agricultural sector, using about 64%. The shares consumed by tourism and industry are 4% and 2%, respectively, while the municipal share is 30% (WAJ, 2009). Since the main priority in Jordan is domestic water use, the freshwater share used for non-potable purposes is expected to decrease in the future. Currently, the inadequate supply of available fresh water for farming discourages the establishment of new agricultural projects, which, in turn, impacts living standards and economic growth.

Jordan's 2009 Water Strategy stated that "Wastewater shall not be disposed of; instead, it shall be a part of the water budget." Accordingly, beneficial use of reclaimed water has been recognized as a crucial component of Jordan's integrated water resources management and

an important tool for effective freshwater conservation. However, use of treated wastewater as a resource has not been completely deployed yet and can be further promoted and developed. This use would ease the stress on existing freshwater resources and improve the livelihoods of many communities across the Kingdom.

USAID has been supporting the Government of Jordan (GoJ) since at least 2002 in efforts to promote water reuse through a range of actions. Progress has been made, but more work is still needed to manage water reuse in an economically feasible, technically applicable, socially acceptable, and safe manner.

1.2 Wadi Mousa Pilot Background

In 2002, the water reuse pilot at Wadi Mousa was established by the USAID Water Reuse Implementation Program (WRIP), following the commissioning of the Wadi Mousa wastewater treatment plant (WWTP) in 2001. The pilot supported the use of alternative water sources (such as treated wastewater) for irrigation of fodder crops, to develop the agricultural and livestock sectors in the area and enhance the livelihood of the local community. The pilot project started with a 6.9-ha demonstration project.

In 2004-2007, the USAID Water Reuse for Agriculture, Industry and Landscaping Project (RIAL) provided further assistance to the pilot. At the beginning of the RIAL project, 14 farms with a total area of 36.9 ha were established, with a cropping pattern of 17.5 ha. During the first two years of the RIAL project, the farms were increased up to 20 farms; 6 of these farm units were allocated to female farmers. The RIAL project expanded the farming area to an additional 21.8 ha of suitable area with the total project area reached 58.7 ha. By the end of the RIAL project, the cropping patterns were found as 14 ha of fruit trees, 15 ha of alfalfa, and 20 ha of barley and wheat , distributed over 39 farm units.
More detail about the pilot can be found in the WRECP report titled *Comprehensive Review of Water Reuse Pilot Projects, 2011*. The report includes a review of the previous reports developed for the pilot, and an assessment of the pilot's conditions, for use as a baseline for the technical assistance plan.

However, although these two USAID projects were successful in establishing concepts, they had limited success from a sustainability perspective. Sustainability in general is defined as the capacity to exist and/or continue (e.g., human, social, economic, and/or environmental benefits) (Schröter, 2010). The sustainability of the Wadi Mousa Pilot Project can be measured as the ability of the pilot to continue functioning and benefiting the farmers and local community after the USAID project is over.

During 2010-2015, the USAID Water Reuse and Environmental Conservation Project (WRECP) provided technical assistance to revive the pilot and make it sustainable. The WRECP conducted training (as the core activity) in a range of topics, to foster improved, sustainable management of the Water Users' Association (WUA) and the pilot project. The WRECP studied available information about the pilot and met with the WUA and farmers to gain their insight and thus determine what kind of assistance would work and then prepared a technical assistance plan. The technical assistance plan included training the farmers to rehabilitate the irrigation system; training farmers in irrigation and best farming practices, agribusiness planning, building marketing chains, and establishing a seed production farm; and training the WUA board in management and finance.

In 2013, the Sad Al Ahmar Water Users Association (WUA) was established, to be the operator of the pilot under the supervision of the Hashemite Fund for the Development of Jordan Badia (HFDB). The main goal in establishing this association was to provide a

mechanism for making the project financially self-sustaining after the USAID projects were finished. The WUA manages the delivery of the effluent from the Wadi Mousa WWTP to the farms within the pilot. In addition, the WUA owns machinery that it rents to the farmers.

As called for in the technical assistance plan, WRECP conducted a study to assess the socio-economic impacts of the water reuse activities on the reuse community (farmers and WUA). The study also assessed the impacts of the technical assistance plan on achieving the sustainability of the pilot, including consideration of whether and to what extent the farmers are benefiting from the pilot, and whether the benefits would be expected to continue. This study is the subject of this report.

1.3 Socioeconomic Study Scope

The primary objective of this socioeconomic study is to assess the socio-economic impacts of the water reuse activities on the reuse community (farmers and WUA) and to analyze the effect of providing the technical assistance on the financial sustainability of the pilot; identify areas of concern and challenges facing the sustainability of the pilot; and define next steps to further promote the socio-economic sustainability of the pilot.

Section 2 of this report describes the methodology used to conduct this study: collecting data, identifying the main socioeconomic indicators. Section 3 explains the socioeconomic impact analysis itself. Section 4 discusses the pilot project's sustainability, lessons learned, and recommendations for next steps to further promote the pilot project's sustainability.

2 Study Methodology

This section describes the methodology followed in conducting this study.

2.1 Desktop Research

Desktop research provided a detailed description of the Wadi Mousa area, pilot history, pilot components, stakeholders, and lessons learned from the previous pilots. The following reports and documents were reviewed:

- Sixth Seasonal Progress Report, RIAL,2008
- Wadi Musa Water Reuse Site Sustainability Report, RIAL,2006
- Business Plan for Wadi Musa Water Reuse Project, RIAL, 2006
- Wadi Mousa Water Reuse Project. Report from Project Manager to the Hashemite Fund for Development of Jordanian Badia (HFDB), 2009
- Land Tribal Zones and Sustainable Development in Wadi Mousa, 2010 (published report)
- Wadi Mousa Water Reuse Site Sustainability Report, RIAL, 2006
- Comprehensive Review of Water Reuse Pilot Projects, WRECP, 2011
- WRECP technical assistance plan for the Wadi Mousa Pilot, 2011
- MoU for using the reclaimed water produced at Wadi Mousa WWTP between HFDB and WAJ, 2008MoU for using the reclaimed water produced at Wadi Mousa WWTP between HFDB and Sad Al Ahmar WUA, 2008
- MoU for providing technical support to Wadi Mousa Pilot between USAID and HFDB, 2013

2.2 Data Collection

The data collected was both qualitative and quantitative in nature. In the qualitative data collection, the primary focus was on social data and was collected through a survey and a number of meetings with stakeholders. In the quantitative data collection, the primary focus was on physical and economic data including financial reports.

2.2.1 Qualitative/Social Data Collection

Qualitative data collection process included the following steps.

Pretested survey questionnaire. The project developed, pre-tested and administered a questionnaire, which covered the following.

- People's awareness of the pilot project and problems raised by its implementation
- Socio-economic data about the interviewee and his/her family; their preferences and ability to participate or share the same land with others in the pilot project
- Suggestions to improve the pilot project
- Negative impacts of the pilot project on their daily life
- The level of education, field of work, size of the family; their education; and the age of the head of the family

After the field survey was completed, data bank base structures were designed, and the data from questionnaires were entered. The checking of the data and correction of errors in transferring took place during the survey and during the entering of the data.

Focus group meetings. The main goals of these meetings were to discuss the expected impacts of the project on participants' daily lives; their opinions about the negative and positive impacts, how these negativities could be avoided; and how the positives could be sustained. Mitigation measures to reduce the negative impacts and to enhance the positives were proposed, and necessary follow up / monitoring activities related to socio-economic conditions including gender aspects were formulated.

Two focus group meetings were conducted with local people in the villages within the pilot project area; at each of them at least seven persons participated. An additional focus group meeting was held with five farmers in the WUA; and an interview with the Director of the WUA was conducted.

Focus meeting with the WUA board and farmers: from the right; Abdalla Eid, board; Ali Mohammad, board; Hussein Ammarien, farmer; Mohammad Majdalawi ,WRECP socioeconomist; Ala'a Homaidan, project team; and Hussein Salameen, farmer.

Face to face survey. The main goal of the face to face meetings was to investigate the opinion of individuals living in the villages in and around the pilot project area. Sampling of information was based on a stratified random sampling plan in three villages in Wadi Mousa. These three villages are near the treatment plant and involved in the project. The beneficiaries of the project are living in these villages; the members of the water association are also from these villages

2.2.2 Quantitative data collection

The primary focus of the quantitative data collection was on the physical and economic dimensions of the pilot over time, including: the WUA, farmers' income and expenses, pilot resources, pilot area and cropping patterns, forage production yield, and water consumption. The main references used in the quantitative data collection were the annual financial records of the WUA, the WUA machinery management records, the survey maps developed by the previous USAID projects and WRECP project, and the site visit reports by WRECP.

Annual financial records. According to the internal law of the WUA, the administrative board is responsible for developing the annual balance sheet of the WUA. The balance sheet should include all income and expenses for 12 months, starting in January. In addition, the accounting records are annually audited by the Jordanian Cooperative Corporation (JCC), following the Jordanian cooperative law 18/1997. WRECP reviewed the annual records for the years 2010 through 2014. The annual records include the following:

- Number of members
- Shares; stocks owned by the farmers
- Auditing report
- Income and expenses balance records
- Detailed expenses and income
- Inventory list, including costs
- Land renting fees
- Bank records
- Budget

Machinery management records. For accounting purposes, the WUA records receipts of the machinery income on monthly basis. The rates that farmers are charged for using the equipment are voted on by the general assembly of the WUA. Each record includes:

- Farm unit code
- Farmer name

- Agricultural process
- Paid rental fees, as agreed on per the internal law of the WUA.

Analyzing these records helped the WRECP team evaluate the annual frequency of cutting (harvesting), mowing, baling, plowing and other agricultural practices for each farm. Furthermore, the extracted data indicated the actual production for each farm, in addition to the agricultural practices for each farm.

Survey maps. WRECP surveyed and mapped the actual cropping pattern at the pilot. Crop types and areas allocated to each were tracked onsite. The WUA is collecting rental fees according to the cropping patterns documented in RIAL documents, so identifying the actual planted areas is significant to document efficient use of the agricultural machines in the pilot project. In addition, the survey included an evaluation of the on-farm irrigation networks at each farm unit, including measurement of the water flow and pressure at each farm. This survey was conducted as part of the informal training for the farmers, to enhance their capacity to monitor their irrigation networks.

Site visit reports. During 2010-2014, WRECP team visited the pilot project regularly for on-site investigations. The team met with: most of the farmers, as the beneficiary members of the WUA; non-benefiting members; the boards (there were two boards during the mentioned time period); potential local customers; family members who were working at the farms; and other stakeholders. The visits documented agricultural and managerial practices. Irrigation scheduling was evaluated as well during all week days. Knowledge gaps, improper agricultural practices, marketing problems, and networking and communication gaps were documented as well. Collected data were used to identify technical tools that need to be provided for the pilot operators and direct water users, in order to enhance the pilot project's management and maximize benefits.

2.3 Socio-economic Impact Fields and Indicators

Based on the desktop research and data collected, the most important "socioeconomic impact fields" to be considered in the analysis were identified. Also, the indicators for each field were identified, considering guidelines for socio-economic studies (Abdrabo and Hassaan, 2003), as shown in Table 2-1.

Table 2-1: Socio-economic impact fields and indicators assessed for the Wadi Mousa Pilot

Impact Field	Indicators
Pilot Infrastructure	− Management strategies of the pilot under the WUA − Efficiency of the water conveyance infrastructure − Marketing patterns, including storage facilities, sales, and protocols − WUA structure and membership − Number and distribution of agricultural equipment
Demographic Conditions	− Population characteristics in the study area, including distribution by age, gender, educational level and family size − Social relationships among the direct effluent users and other societies − Social relationship among benefiting and non-benefiting members
Pilot Resources	− Land resources (cropped areas, ownership, and rights of use) − Plant resources (cropping patterns, types of crops and their distribution, production, and agricultural management) − Human resources, including operators of the farms, WUA board, pilot operators, and labor − Water resources, including effluent supply and effluent demand

	in terms of quantities and qualities − Livestock resources (existing livestock and potential expansion under the pilot)
Economic Conditions	− Job opportunities, including previous and existing employment composition, and potential new job opportunities − Previous, current and expected income for both the farmers and the WUA − Financial resources (external funds, income resources and revolving fund)

These indicators were assessed, using the comparative assessment method through analyzing costs, benefits, and risks. This approached helped in measuring the impact of implementing the technical assistance plan on the pilot through comparing previous and current socio-economic activities. Results of the analysis of the above-mentioned indicators are presented in the next section, with the sustainability measures addressed for each.

3 Socio-economic Impact Analysis

This section explains the results of the socioeconomic analysis. That is, the pilot's impacts on each socioeconomic impact field (pilot infrastructure, demographic conditions, pilot resources, and economic conditions), are analyzed.

3.1 Pilot Infrastructure

The main components of the pilot infrastructure are:

- Irrigation network infrastructure, consisting of sand filtration unit, pumping unit, the main irrigation pipeline, manholes distributing effluent to the farms, and on-farm irrigation systems
- Project area of 1069 donums, including 41 farms units, one demonstration farm, and one alfalfa seeds production farm
- Marketing center (storage warehouse)
- WUA building
- Agricultural machines, including (currently) three tractors, three cutters, two mowers, three ploughs, two balers, one thresher, and one pesticides sprayer tank

3.1.1 Irrigation Infrastructure

WRECP helped the WUA and the farmers rehabilitate the irrigation network. The WUA board and farmers were trained on the maintenance works and on conducting regular check-ups for the irrigation infrastructure, each according to their specific responsibilities. Accordingly, the rehabilitated network is expected to work efficiently. Farmers are expected to start rehabilitating their on-farm irrigation network by 2019-2020

The pilot infrastructure consists of an irrigation water pond located within the WWTP boundary, two irrigation pumps, three sand filter units next to the irrigation pond, and the main water distribution network leading to the irrigation head units to each farm unit. The irrigation system at each farm includes a sub-main line, manifolds, laterals, and head units. WRECP's 2011 field investigation showed that the irrigation system was suffering from low operating efficiency due to leakages, clogged filters, damaged valves, poor distribution, and mismanagement.

Rehabilitation work, performed by farmers in the context of training sessions, included replacing the sand filtration unit, the distribution valves, and the on-farm head units. After the irrigation infrastructure had been rehabilitated, a hydraulic simulation was conducted to estimate the water pressure received at each farm unit, according to different scenarios of irrigation schedules. After viewing the results of the simulation, the WRECP team recommended a new irrigation schedule; this schedule was followed successfully and enhanced the water pressure. Water pressure was measured at around 1-2 bar at each farm unit, ending complaints from the farmers in this regard. Furthermore, the new water pressure is consistent with the results of the hydraulic simulation model developed by WRECP.

WAJ owns the main conveyance line and is responsible for its maintenance and replacement. WAJ is also responsible for operating the system from the treatment plant to the farm units' gates. The WUA is responsible for the operation and maintenance of the sand filters and the sub-mains. A trained irrigation supervisor, paid by the WUA, opens and closes the valves according to a fixed schedule and conducts daily maintenance. The farmers are in charge of their on-farm system from the head units to the drip lines. They check, maintain and replace their equipment when necessary.

At Wadi Mouse pilot project: replacement of sand filtration unit valve replacement; and rehabilitation of on-farm irrigation networks.

Results have been demonstrated through the enhanced uniformity of the planted crops, increased forage production and expanded planted areas, documented within the WUA financial documents. Nine units were rehabilitated, and two new units were planted with forage crops, including one by a new female farmer. In fact, the farm units at the highest elevations were not planted before 2013, as the water pressure received at those farms had been insufficient to irrigate forages. Those farms were rehabilitated and are now producing forages with a satisfactory uniformity of crop growth following the water pressure improvements. For example, the farm unit number 5 was not planted for the years 2010-2013 due to insufficient water pressure received at the farm. However, enhancing the efficiency of the irrigation infrastructure improved the pressure at the farm, which was recorded at around 2 bar. As a result, the farm was replanted again with an area of around 1.5 donums of barley and 2.5 donums of alfalfa.

3.2 Management Strategies

The pilot is being operated by Sad Al Ahmar WUA, under the HFDB supervision. The HFDB was responsible for assigning a project manager according to the signed MoUs in 2008. However, the project manager resigned before the start of the WRECP implementation. The WRECP team coordinated with the WUA and HFDB on this issue, resulting in the assignment of a new project manager who is responsible for technical support for both farmers and the WUA. According to the board and the farmers, the working days for the manager are not enough for a proper supervision for the pilot. The WRECP therefore suggested having a full time manager for the pilot project who would supervise the agricultural work seven days a week. The WRECP team assessed the feasibility of assigning the manager with a different suggested fund for his salary. The feasibility estimations are described in detail in section 3.4.3.

According to the previous MoUs signed between WAJ, HFDB and WUA, the WUA became responsible for operating and maintaining the pilot project in August 2013, assuming 100% of the financial responsibilities for rehabilitation work. Before then and to date, the WRECP team has supported the management of the reuse activities under the WUA through identifying challenges and providing technical support.

The WRECP worked on enhancing the capacity of the WUA board and members. The project trained the board of the WUA on financial management of WUA. Moreover, the project team conducted on-field training for the farmers of Wadi Mousa. The trainers promoted best, safest and most profitable practices of forage production under reclaimed water.

The overall results of building the capacity of both the WUA board and members were positive. The following elements were enhanced:

- Financial management of the WUA as per the annual budget records; annual income increased.
- Technical management of the pilot as a cooperative, as per the monthly operational records of the WUA; membership collection fees increased.
- Technical and financial management of the farms under the pilot, as per the machinery monthly records; forage production yield increased

WUA structure and membership. Sad Al Ahmar agricultural cooperative association for reclaimed water reuse (WUA) was established in 2002. The WUA is a democratic association, managed through an administrative board elected every two years. A committee of three foundation members, including one female, set the internal law of the WUA.

According to the internal law of the WUA, the administrative board includes at least three members. The current board includes five members: the WUA head, head deputy, secretary, accountant and treasurer. The board manages the WUA through tracking and documenting the financial records, coordinates with the Jordan Cooperative Corporation (JCC) for annual auditing, accepts new members, collects the eligible fees, assigns an accountant and pays for his salary, and supervises the reuse activities at the Pilot.

The main indicators related to enhancing the management strategies of the pilot project through the WUA are collected water fees, number of WUA members, and number of benefiting members. Impacts on these indicators are described in the economic section of this report

Water fees. The WUA is responsible for collecting water fees from farmers, and paying it back to WAJ, according to the signed MoU. Field investigations revealed that farmers did not pay for the water fees for the 2012 to 2014 time period. . Farmers were claiming that they did not receive sufficient water flow at their farms, resulting in decreased productivity. The eligible water fees were 0.01 JD/m^3 for the produced effluent of 2,400 m^3/day. This is because all produced effluent was pumped to the farms. The WRECP team coordinated between WAJ and the WUA board to set an agreement for collecting the eligible fees in several stages. The WUA owes WAJ approximately 27,948 JD in water fees for the three years. Adherence to the improved irrigation schedule can minimize water fees on farmers by 34%and result in 3,333 JD per year of savings. On average, this is equivalent to 70 JD/year per farmer (48 farmers).

Membership. The WUA was established in 2002 with 20 members, including three females. Benefiting members of the WUA have the right to plant their crops at the pilot project, according to the WUA's internal law. In 2009, the WUA included 114 members, out of which 40 were benefiting – representing 35% of the total members. In 2011, the total number of members increased by 8%, up to 123. The members included 28 females, representing 23% of the total number of farmers. Non-benefiting members started complaining because they were not benefiting from the pilot, so the board stopped accepting new membership applications.

Increasing benefits to Membership was considered in the technical assistance plan developed for the project, which included face-to-face meetings with the board and non-benefiting members to investigate potential opportunities for supporting the WUA in developing plans for those members. The non-benefiting members suggested establishing new projects such as livestock ranching and beekeeping. Therefore, the WRECP included livestock management within the training plan developed for the pilot, to help the WUA and its members understand the effort required for establishing and managing such activities.

The total number of benefiting members was increased up to 48 farmers, representing 40% of the total number of members. In other words, the number of benefiting members was increased by 20% during 2009-2014. The percentage of beneficiaries is expected to reach 50% after operating the revolving fund that was planned to benefit at least new 10 members, according to the WUA board.

3.2.1 Availability of Agricultural Machines

One of the important benefits for any member of the WUA is using the agricultural machines belonging to the WUA for producing forages at their farms.

The WUA owns two tractors: the first is a big John Deere model; the second is small and is used to cultivate between the fruit trees. The John Deere was funded by USAID and imported from USA directly, so the spare parts are not available all the time. In addition, the spare parts for this tractor were very expensive Recently, the hydraulic system was broken, so it was replaced with a local manufactured one which is not as efficient as the original..

Baling Alfalfa at Wadi Mousa

The WRECP team supported the WUA in comparing the costs of purchasing a new tractor or paying for the maintenance of the John Deere tractor. Accordingly, the WUA decided to buy a new tractor locally, following the specifications recommended by WRECP. The new tractor and agricultural equipment supported organizing of the agricultural work at the farm units. Prior to buying the new tractor, some of the farmers had faced decreases in their production quality, because they had had to wait too long for their turn to harvest their crops.

The WUA also owns one alfalfa cutter, one bailer, one disc plough and one duck-leg plough. The machines are operated by one driver, working under WUA supervision. The HFDB is responsible for paying his salary of 300 JD/month.

Equipment purchased between 2009 and 2013 is summarized in Table 3-1. The WUA had been able to pay for a new cutter and mower in 2009, because 3,500 JD in revenues were collected during the previous year. In 2010, the WUA paid around 10,000 JD for a new tractor, cutter and plough (duck-leg). In 2012, Ministry of Planning and International Cooperation (MoPIC) provided funding for new agricultural machines; the WUA paid 25% of the new machines' cost of 15,156 JD, while the remaining 75% was funded through MOPIC.

Table 3-1: Available agricultural equipment at the Pilot during 2009-2013

Year	2009	2010	2012
Cutter	1	1	1
Mower	1		1
Tractor		1	1
Plough-duck		1	1
Plough-disc			1
Baler			1
Thresher			2
Machine warehouse			1
Pesticides sprayer tank			1

Although this new equipment significantly increased forage production at individual farms, it resulted a high financial cost on the WUA for hiring a second driver. The WUA paid 3,520 and 8,820 JD for salaries in 2013 and 2014 respectively. This decreased the annual revenues of the WUA by 5,300 JD in 2014.

3.2.2 Marketing

Achieving sustainability has been at the forefront of all the WRECP activities at the site. The project's technical assistance activities include agribusiness planning and building marketing chains and infrastructure. USAID and the Hashemite Fund for the Development of Jordan Badia (HFDB) signed an MOU confirming support for increasing and improving management of water reuse in Wadi Mousa and other regions of the country. The WUA signed an MoU with a private company specialized in importing and exporting forage crops. The MoU will enable the WUA to sell the pilot's bulk production of alfalfa at local market prices to sustain the financial security of farmers and the WUA.

WUA board member; Ali Ammarine explained that the majority of the farmers are storing their forage production at the marketing center (warehouse).

Most of the farmers did not have proper storage for their production, which meant that they could not maintain the quality of their production. In addition, they were facing problems in marketing, which decreased the price of the forage and their profit. The project established a marketing center that introduced a proper storage facility for use by all the farmers who belong to the WUA). The WUA staff was trained on handling and storing alfalfa, and on managing the center.

This helped maintain a good forage quality and a product that can be sold for a better price. In addition, the WRECP supported the WUA in new marketing strategies through introducing the pilot to potential national customers. The new strategies also included developing an MoU between the WUA and Al-Qabas Forage Company, with the aim of selling the forage produced at the pilot as one entity. This can introduce a new income source for the WUA, bringing in 0.25 JD/bale if sold through the WUA as a cooperative.. For instance, the optimum production of alfalfa for the pilot is estimated to be 30,136 bales/year, according to the current cropping pattern (year 2014). This can provide an extra income for the WUA of about 7,500 JD/year that could, for example, cover the salary of a second driver for the agricultural machines belonging to the WUA.

Currently, the marketing center contains more than 1,000 bales of alfalfa. Although the MoU is not yet effective, it is expected that the bales will be sold for an average of 5 JD/bale, in comparison to the previous 3 to 4 JD/bale. It is expected that the income for both farmers and the WUA will increase by around 25% through applying this MoU in the near future.

3.3 Demographic conditions

The demographic characteristics of the pilot area were analyzed using both face-to-face meetings with participants and meetings with the WUA board. This is to explore to what extent the area was affected by the reuse activities and the implemented technical assistance plan.

3.3.1 Socio-demographic Profile

The pilot is located in Ma'an governorate, within the Liwa of Petra (See Figure 3-1). The main targeted areas studied in the demographic profile are those of the benefiting members of the WUA as farmers allocated to farm units under the Wadi Mousa Pilot, within Wadi Mousa town, Um Sayhoon village and Bayda village. The area of Wadi Mousa where the Layathneh tribe lives includes approximately 55% of the population of the Liwa of Petra. Baydha village is the nearest town to the project location, and represents two sub-tribes of the Ammarine. It should be noted that there are two other sub-tribes of Ammarine who do not live in Bayhda. Those are the Salamieen who are living in Dlaghat (Shoubak), and the Showashe who are living in Wadi Araba (Qrayqare). (Tarawneh, 2009.) Um Sayhoon village was taken into consideration as it falls between Baydha and Wadi Mousa town. (See Table 3-2.)

Figure 3-1. Location of Wadi Mousa Pilot project

Table 3-2: Families with members of the WUA and associated living areas (Tarawneh, 2009):

Living area	Tribe	Sub-tribes
Wadi Mousa	Layathne	Shamaseen, Amarat, Halalat, Hasanat, Nasarat, Salameen, Mashaale, Khlaifat
Baydha	Ammarine	Kabayre
Qrayqre	Ammarine	Showashe

Ammarine is the main clan in the region, with 95 members of Sad Al Ahmar WUA. The Ammarine clan includes two tribes: Al-Salmanyeen and Al-Showashe. The elderly people of these tribes nominated the beneficiaries. The farm units were distributed among farmers, based on clan or tribe rights. The Wadi Musa Army Veteran Society nominated ten local people to benefit from these units. According to the WUA board, retired military members were increased recently to 16, including six females, all from Wadi Mousa village. The other beneficiaries have been chosen based on the tribe families in Bier Al Dabbaghat, Qrayqra, Wadi Mousa village, and Beidha village.

According to the studied group and questionnaire analysis, the average age of the head of the family in the study area is 48 years. The heads are not well educated: 42% of the heads are illiterate, and about 32% finished primary school, while the rest finished elementary school. Job opportunities in the villages are few: 23% of the heads of the families are jobless, and 26% are retired. About 23% of the interviewees indicated they would prefer to change their residence to improve their living standard and find a good job opportunity.

Table shows the average size of the family, which is 5.5 members, with almost equal percentages of females and males. Jordanian society is currently characterized by a high percentage of young people. This is also true for the study area, where the percentages of population between 14 and 60 are 38% male and 41% female, and 13% of the total population is less than 14 years. This impacts development of the local community and the need to find job opportunities. The burden is heavy on the head of the family to cover the needs of the family.

Table 3-3: Demographic data of the members of the families in the survey

Criteria	Number	Percent %
Members of family	5.45	100
Male	2.74	50
Female	2.71	50
Male (14-60)	2.07	38
Female (14-60)	2.26	41
Male more than 60	0.31	6
Female more than 60	0.09	2
No. of employees	1.52	28
No. of female employees	0.29	19
No. of male employees	1.22	81

The number of people in the project areas who are over 60 years old is low: 6% male and 2% female. The gender ratio has been calculated by dividing the number of males by the number of females. The distribution of males and females in different age level is close to equal, as shown in Table above. The percent of women considered economically active is the same as that for men, but there are differences in the responsibilities between males and females in these societies: the male has the responsibilities to work outside, while the female's tasks are mainly in the house. For analytical purposes, to estimate the real labor force in these societies, the labor capacity of family members is standardized according to age classes. A full man equivalent (ME) was assigned to members at an age between 14 and 60 years and 0.5 ME was assigned for members above 60. Based on these assumptions, the total ME in this area is 83%. This shows that the labor capacity of the

family is high in the project area. However, only 28% of the total family members are working.

The difference between the labor capacity and the percent of employed members illustrates the importance of implementing projects like this pilot project. The percent of employed males is four times that of the percent of employed females, because the culture in these societies considers the work outside to be the responsibility of the male. Since the area is near a tourist destination (Petra), most of the job opportunities are in the private sector (in tourism), accounting for about 41% of total working people. Government employment accounts for about 49%.

3.3.2 Networking

Water User Associations are considered important in strengthening the social relationships between the farmers in a project and other water re-users. The WRECP supported the WUA developing networks with national and international water re-use associations.

Local level

In 2002, at the start of the original pilot, a socio-economic study was conducted to identify the eligible tribes and families that could benefit from the pilot (Tarawneh, 2009). The study presented the pilot area (farms) as a government-owned land which falls within what originally was called the "Ammarine tribal zone." In addition, the land around the project area is owned by members of the same tribe. Local tribal customs prevent any person from outside the Ammarine tribe from using the land. However, the study stated that the Ammarine were a small percentage of the citizens of the Wadi Mousa at the time of establishing the pilot (around 400 persons). As the pilot supervisor, the HFDB was interested in supporting the local community, many of whom had different tribal backgrounds. Therefore, the HFDB introduced another local tribe (Layathneh) to the pilot as beneficiaries to avoid tribal conflicts due to the small number of Ammarine in the area. The selected beneficiaries were members of the Wadi Musa Army Veteran Society. This retired military association was dissolved, and its members were assigned as new members of the Sad Al-Ahmar WUA.

As a result of implementing the technical assistance plan for the Wadi Mousa Pilot, it was obvious to all the members of the WUA that income and benefits were increased. The potential for increased income and benefits introduced the concept of competitiveness in work and achievements among the WUA members. Consequently, each tribe tried to increase its share of land so as to increase the benefits for the tribe, which created a tribal conflict at the area and highlighted the fact that it originally fell within Ammarine tribal zone. Currently, the HFDB is working with the WUA board on resolving this problem.

National level

As mentioned above, the WRECP project worked on enhancing the capacity of the WUA board and members. The project trained the WUA board on financial management. The 4-day training workshop also included representatives from all associations practicing water reuse in agricultural production around the kingdom. The WUA started to build its network in order to share knowledge and experience in water reuse. At the end of the workshop, the boards attend the training verified the value of the training and asked why they had not been brought together before.

The most important outcomes of the training workshop can be summarized as follows:

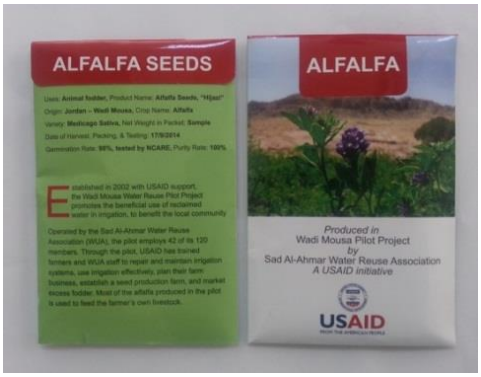
- Support for networking and knowledge sharing among water re-users around the Kingdom grew

- Farmers started visiting other reuse sites from different governorates to learn from their experiences
- Farmers in Ramtha introduced drip irrigation to their reuse site, as Wadi Mousa promoted the use of the "high efficient pressurized systems" in increasing water productivity

During the workshop, the participants requested study tours to the reuse sites around the kingdom. Thus, the training schedule was updated to include a visit to the reuse site around As Samra WWTP in Zarqa governorate. Participants learned about the management strategies of As Samra and Al Mazra'a WUA, as well as about the planted crops and agricultural machines belonging to As Samra and Al Mazra'a WUA.

Sad Al Ahmar WUA board members participated in As Samra study tour.

As part of the knowledge sharing among water re-users in Jordan, the WUA board attended the opening of Al-Lajjoun pilot reuse project which was designed and implemented by WRECP. As the Al-Lajjoun WUA board attended the 4-day-training mentioned above, they were part of the network developed around the Kingdom. Therefore, Sad Al Ahmar WUA board was invited to the Al-Lajjoun event. Two board members from Sad Al Ahmar WUA attended the opening of Al-Lajjoun, and they distributed packets of alfalfa seeds produced at the Wadi Mousa Pilot seeds production farm, to illustrate the project's success.



Packets of seeds produced at Wadi Mousa pilot were distributed to show the success of producing alfalfa seeds under reclaimed water.

International level

As part of promoting the Wadi Mousa pilot as a model for water reuse to enhance livelihood for local communities, the WRECP project arranged and supervised two study tours to the pilot from outside the country. The first tour was arranged with the Water and Health Organization (WHO) for stakeholders from Bhutan and Barbados. Participants were interested in best scenarios for reusing effluent with zero discharge in coastal lands like their own. At the end of the tour, they stated that they believed that using effluent in irrigation is environmentally safer than dumping it into the sea.

Another tour was arranged for new water re-users from Palestine. The tour was arranged with the Ministry of Agriculture (MoA) and the National Center for Agricultural Research (NCARE) for the stakeholders of a new project that will be established in Palestine, Jeneen. Participating farmers were members of the newly established WUA of Marj Ebn Amer. Participants learned the importance of working under a cooperative as one party in operating a successful reuse project.

Visitors from Barbados and Bhutan.

Visitors from Palestine, Marj Ebn Amer WUA.

Two study tours promoted the Wadi Mousa Pilot internationally.

3.4 Pilot Resources

3.4.1 Land Resources

The reuse activities in Wadi Mousa Pilot were established on an area of 100 ha, out of which 66.9 ha were divided into 40 farm units.

Land Ownership: The pilot site in Wadi Mousa is owned by the Petra Regional Authority (PRA), which authorized the use of the land. The irrigable area within the government-owned land in Wadi Mousa had already been explored during the WRIP and RIAL projects. However, there is privately-owned land within the same area, and the farmers are hoping to expand the project area to the private land. The planting of tree crops proposed by the farmers appears to be related to the land ownership issue, as tree plants will stay with the land for a long time.

Eligibility of use: At the establishment of the Wadi Mousa Pilot, farms were allocated to the WUA members who had not been working in full time jobs according to a socio-economic analysis. However, a new farm was allocated to a new female member of the WUA during 2010-2014, in accordance with the eligibility conditions documented in the internal law of the WUA. Members who paid their membership fees and joined the WUA earlier than 2010 are eligible to plant the new farms. For instance, a female farmer was allocated farm unit number A2, which was planted with 0.33 ha alfalfa and 0.43 ha barley, for a total area of 0.76 ha. The WUA is planning to allocate other members to three empty farm units which were not cultivated before (2, 4, and 7), in addition to the alfalfa seeds production farm (farm unit number 24) which was established by WRECP as a demonstration farm.

Cropping patterns: The cropped area prior to the establishment of the WRECP (2010) was reported as 50 ha, including 14.4 ha of fruit and olives, 15.1 ha of alfalfa, and 20.5 ha of winter crops (barley and wheat). The total area planted with forages was 35.6 ha. In 2013, the area planted to forage reached 45.8 ha, an increase of 29%.

In 2013, the area of alfalfa increased 20% to reach 18.1 ha in 2013. Also, the area of winter crops (barley and wheat) was increased to 35% to reach 27.7 ha (see Figure 3-2).

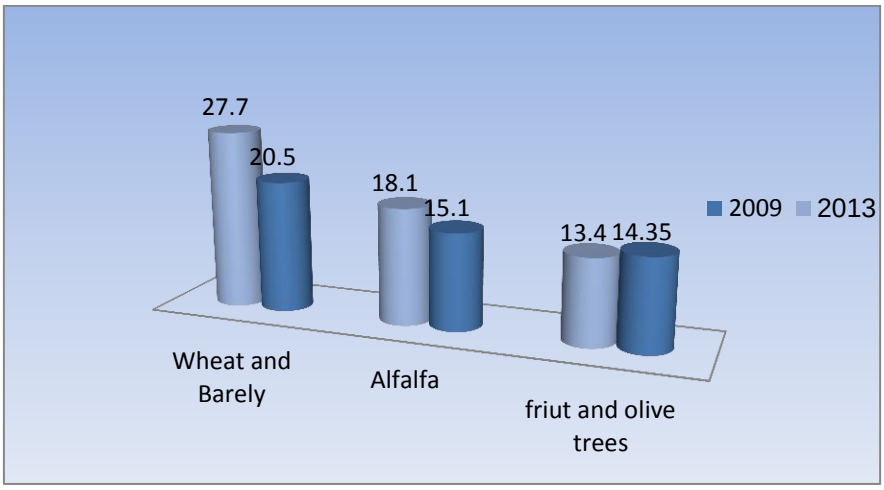


Figure 3-2. Change of cropping patterns at the Pilot between 2009 and 2013 (ha).

3.4.2 Water Resources

The farms at the pilot are irrigated using the effluent produced at the Wadi Mousa WWTP through a conveyance irrigation network installed in two phases under WRIP and RIAL. In 2004, the delivery of reclaimed water was governed by a formal Memorandum of Understanding (MOU) between the Petra Regional Authority (PRA), WAJ and the Badia Research and Development Program (BRDP). This MOU guarantees farmers access to the reclaimed water in exchange for a fee of 0.01 JD/m^3.

Water quality and quantity. The quality of water is suitable to be used for fruit trees and field crops according to JS 893/2006. The Aqaba Water Company (AWC) is operating the WWTP under the supervision of WAJ. AWC is collecting effluent samples on monthly basis for quality monitoring purposes. The design capacity of the Wadi Mousa WWTP is 3,400 m^3/day, with the capacity of producing an annual effluent of 1,241,000 m^3/year. The average actual daily effluent was recorded as 2,570 m^3/day during 2009-2013, which is equivalent to 938,050 m^3/yr.

Water irrigation requirements. The WRECP developed a water balance study for the pilot. Actual irrigation requirements were estimated for proper irrigation scheduling management. The study aimed at enhancing water productivity at the pilot, in addition to improving the irrigation schedule. Proper scheduling can help evaluate future possibilities of expanding the planted areas using the estimated surplus water quantities.

The water balance estimated the Gross Irrigation Requirements (GIR) for alfalfa and barley as 15,500 and 1,900 m^3 per hectare respectively, while fruit trees and olives are rain fed crops at the pilot. Wheat is also planted as a winter forage crop by means of crop rotation. As part of the training plan, farmers were trained on the importance of adopting a proper crop rotation plan in maintaining the soil fertility. As the planted areas were increased by 18% in 2013, the estimated GIR was increased by 24%, which is equivalent to an increase in the annual GIR by 64,830 m^3. Previous on-site investigations showed that sufficient water was not received at most of the farms, according to farmers and the WUA board. However, after the efficiency of the irrigation infrastructure was enhanced with WRECP assistance, sufficient water was received to irrigate the planted cropped areas, as well as the expanded areas in 2013.

The total annual irrigation requirements for the pilot including the surveyed cropping pattern were estimated at 338,066 m^3/year. In other words, an annual surplus of approximately

600,000 m^3/year will be available for expanding the planted area. Taking into account the minimum surplus effluent and the peak irrigation requirements for alfalfa and barely, the areas of potential expansion are presented in Table 3-4. The table shows that an extra area of 16.1 ha can be planted to alfalfa, along with 35.4 ha of barley considering the current average flow received at the Wadi Mousa WWTP. Working with full WWTP capacity, the expanded areas can reach up to 27.1 ha of alfalfa along with 55.8 ha of barley.

Table 3-4: Area and quantity of water project area and quantity of treated water from WWTP

Crop	Alfalfa	Barley	Wheat	Fruit trees	Olive	Total
Total planted area (ha) in 2009	15.1	20.5	-	9.4	5	50
Total area (ha) in 2013	18.1	25.7	2	9.4	5	59.2
Gross Irrigation Requirements (GIR) (m^3/ha)	15,518	1,898	4,203	-	-	
Total Gross Irrigation Requirements (GIR) (2009) (m^3/area)	234,327	38,908	-	-	-	273,236
Total Gross Irrigation Requirements (GIR) (2013) (m^3/area)	280,882	48,778	8,405	-	-	338,065
Change in planted areas (2009-2013)	+20%	+25%		-		+18%
Change in Gross Irrigation Requirements (GIR) (2009-2013)	+20%	+25%				+24%
Maximum potential expanding areas (ha) – (WWTP current flow)	16.1	35.4				
Maximum potential expanding areas (ha) – (WWTP Design capacity)	27.1	55.8				

3.4.3 Human resources

The analysis of human resources focuses on labor forces in the society. In the farm, labor can be provided by family members or by hired labor, which can be both permanent and temporary. The farms require temporary labor for harvesting, fertilizing or other agricultural processes during specific times during the year. The project established 40 farms with average size of approximately 15 Donums. These farms need at least 40 permanent laborers in addition to temporary laborers. Also, the association offered three job opportunities as a driver, accountant and manager. The total job opportunities are about 45. This value is considered high considering the size of the villages around the project.

The HFDB assigned one of the WUA members to be responsible for operating the irrigation network and supervising irrigation scheduling. It was agreed that the HFDB will pay his salary of 200 JD/month. However, the WUA agreed to pay the operator 300 JD/month, as he is also working as an accountant for the WUA.

3.4.4 Livestock Resources

Ma'an governorate contributes 8% of the livestock around the Kingdom, including cows, sheep and goats (MoPIC, 2013). Site investigations revealed that around 50% of the WUA members own livestock. Most of the livestock are being fed on the forage produced at the pilot, whereas some of them get forages for free from their respective families. Direct grazing is seasonally practiced at the farms, which decreases the potential WUA income from renting their agricultural machinery. Barley is directly grazed on almost all farm units in the pilot; for alfalfa, the first cut for the first season is also directly grazed. This can be considered an indication that the forage production at the pilot is higher than that documented within the

WUA financial documents, since direct grazing does not require renting of WUA machines. In addition, the directly grazed forages supply the local livestock with feed stuff at a lower price than other forage resources.

3.5 Economic conditions

This part of the report discusses the impact of the water reuse pilot on the living standards of the farmers and consequently the WUA. Criteria for the living standard include those noted by Doppler (2002), who emphasized the role of living standards as a part of the quality of life and defined basic indicators, described below.

3.5.1 The Pilot Financial Resources

Income resources. The main income resources of the WUA are the machinery rental fees and land fees. Membership fees and shares can be considered minor income resources, as the WUA stopped accepting new membership applications recently. The income resources for farmers through the pilot relate to selling their forage production. The analysis of the impacts on the income for both farmers and the WUA are discussed in detail in this section.

Capital resources and external funds. This part of the report discusses the value of average investment and the source of capital, credit or cash. Table 3-5 presents an inventory of the purchased equipment during 2009-2013 and the funding resources for each.

Table 3-5: Fund resources for purchasing new equipment to serve the pilot

Equipment	Purchase year	Price (JD)	Life span	Depreciation rate	Fund
Cutter	2009	3,000	10	0.1	WUA
Mower	2009	500	10	0.1	WUA
Tractor	2010	7,388	10	0.1	WUA
Cutter	2010	1,908	10	0.1	WUA
Plough-duck leg	2010	600	10	0.1	WUA
Furniture	2010	162	10	0.1	WUA
Gas	2010	29	10	0.1	WUA
Building (equipment storage)	2011	536	20	0.05	WUA
Building (machinery storage)	2012	4,036	50	0.02	WUA 25%, MOPIC 75%
Tractor	2012	24,500	10	0.1	WUA 25%, MOPIC 75%
Spray tank (pesticides)	2012	2,750	10	0.1	WUA 25%, MOPIC 75%
Cutter	2012	4,250	10	0.1	WUA 25%, MOPIC 75%
Mower	2012	4,000	10	0.1	WUA 25%, MOPIC 75%
Thresher	2012	4,500	10	0.1	WUA 25%, MOPIC 75%
Plough-duck leg	2012	1,400	10	0.1	WUA 25%, MOPIC 75%
Plough-duck leg	2012	1,450	10	0.1	WUA 25%, MOPIC 75%
Baler	2012	15,000	10	0.1	WUA 25%, MOPIC 75%
Marketing center	2013	6,720	50	0.02	WRECP

The life span and investment costs of the above-mentioned agricultural machines were considered in the analysis of the pilot potential sustainability.

Revolving Fund: In November 2005, the principal system of the revolving fund was finalized by RIAL project management, the WUA, and several stakeholders. In 2013, the WUA and HFDB signed an MoU regarding the revolving fund that is effective for five years. As mentioned earlier, the development of this MoU aimed to provide the required liquidity for project sustainability. According to this MoU, the capital of the revolving fund was deposited as 2,000 JD by the WUA, and 30,000 JD by the HFDB. Prior to the date of developing this report, the WUA did not start operating the revolving fund.

WRECP provided one-day training, in the WUA offices, on managing the revolving fund.. The main training methods were brain storming and discussion of various strategies for the financial management of the revolving fund. The trainer explained the feasibility of the plans suggested by the board. For example, one of the board members suggested three groups to benefit from the fund:

- Benefiting members, for rehabilitation of their on-farm irrigation networks when needed, and for buying seeds, fertilizers and pesticides, etc.
- Non-benefiting members, for the establishment of new projects such as livestock ranching or bee keeping
- WUA, for investment of up to 30% of the revolving fund for extra income resources

The feasibility of each suggested project was discussed during the training. The WRECP trainers suggested investigating the needs of all members of the WUA (including non-beneficiaries) through meetings to start developing a list for potential fund opportunities. In addition, the team advised the board to develop criteria for priorities of the eligibility to benefit the fund. For example, farmers who will apply for the fund should first pay all their current and past due fees (including land fees, machines renting, water fees, and membership fees). Regarding non-benefiting members, the board stated that they will consider priorities according to paid membership fees and shares, as well as years of being a member. The feasibility of investing 30 percent of fund for the WUA was discussed briefly. One suggestion was establishing a livestock ranching project, wherein feed stuff can be bought through the marketing center, and lambs can be sold to the farmers and non-benefiting members on monthly payments. The team agreed that feasibility studies and management plans can be provided through the project once the board finalized plans for the revolving fund. As the WRECP is close to being concluded, further support can be provided through National Center of Agricultural Research and Extension (NCARE) and MoA.

3.5.2 WUA income and expenses

Through analyzing the annual financial documents of the WUA, the main expenses and income resources of the WUA can be summarized (see Table 3-6)

Table 3-6: Expenses and income resources of the WUA

Type	Items
Income	Machinery renting fees
	Land fees
	Membership fees
	Shares
Expenses	Machinery operational costs (fuel, insurance, license, and baler wires)
	Machinery maintenance costs
	Salaries (drivers of the agricultural machines, and the irrigation network operator)
	Administrative costs (stationary, per diems of the board meetings, accounting and auditing, bank expenses, transportation, and labor)

WUA Income

Machinery renting fees. The income from renting the agricultural equipment and machines was decreasing gradually prior to the start of the WRECP, due to fall off in production, low water pressure, and irrigation network deterioration. The WUA generated an income from renting machines of 11,488 JD, and 9,445, in 2011 and 2012 respectively. The board of the WUA explained that this was due to the following reasons:

- Machinery renting fees were collected according to the areas as planned in RIAL, despite the fact that the cropping patterns and areas were changing. In other words, each farm was planned to plant only 4 donums of alfalfa. Although the farmer planted one more donum with alfalfa, the WUA was still collecting fees for the first 4 du only.
- Some farms were not practicing any agricultural activities due to the low water pressure. Other farms were mismanaged resulting in few agricultural practices during the year. All of this contributed to decreasing the working effort of the WUA machines, and hence decreasing its income.

As mentioned earlier, the WRECP worked to enhance the capacity of the water re-use community in the pilot through providing training for both WUA board and farmers. The board was trained on the financial management of both the WUA and the pilot, while the farmers were trained on best, safest and most profitable practices of forage production under reclaimed water. The overall result was increased capacity of both the WUA board and members. The following elements were enhanced:

- Financial management of the WUA
- Technical management of the pilot as a cooperative
- Technical and financial management of the farms under the pilot

All of the above were reflected in an increase of the WUA income from renting the agricultural equipment, which reached 14,873 and 14,900 JD in 2013 and 2014 respectively, with an increase of 58% of the income generated during 2012, and 30% of that generated in 2011 (according to financial documents of the WUA).

The rates of renting fees were documented within the financial documents of the WUA as shown in Table 3-7.

Table 3-7: Renting fees (JD) for agricultural machinery at pilot

Machine	JD/ha	JD/Bale	JD\hr
Cutter	40		
Mower	40		
Ploughing “Tractor-Disc”			10
Ploughing “Tractor-Duck”			5
Baler		0.5	
Thresher			20
Leveling equipment			5

Land renting fees. Farmers who are allocated to farm units are charged 90 JD per farm unit per year. The land renting fees are collected annually as 90 JD per farm unit; in addition, 300 JD was collected for the farm unit number A3, as it was allocated to 6 farmers. Accordingly, the annual eligible land fees are 3,370 JD.
The collected land fees were decreased gradually during 2011 and 2012, as farmers were not satisfied with their forage production and thus started abandoning the farms. As reported in the financial documents of the WUA, 79%, 60% and 77% of the eligible land fees were collected in the years 2011, 2012 and 2013 respectively. In 2014, the collected fees were increased up to 80% of the eligible fees, in addition to collection of 10% of previously eligible fees. For example, the total collected land fees in 2011 were 3,035 JD, out of which, 360 JD were compensating for eligible fees for the previous years. In 2014, on the other hands, the total collected fees were 3,510 JD, including 830 JD for eligible fees for the previous years. No one paid for any previous fees in 2012, with the total paid fees of 2,030 JD. Thus it can be seen that there was an improvement in the financial management of the WUA, as well as the enhanced satisfaction of the farmers on the performance of the WUA, and on their forage production under the pilot which resulted in ability to collect fees owed See Figure 3-3.

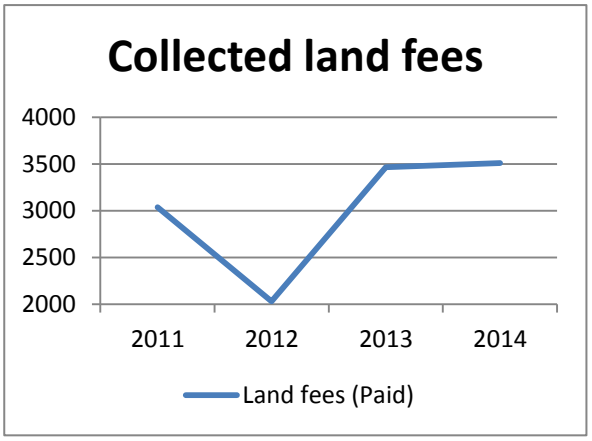


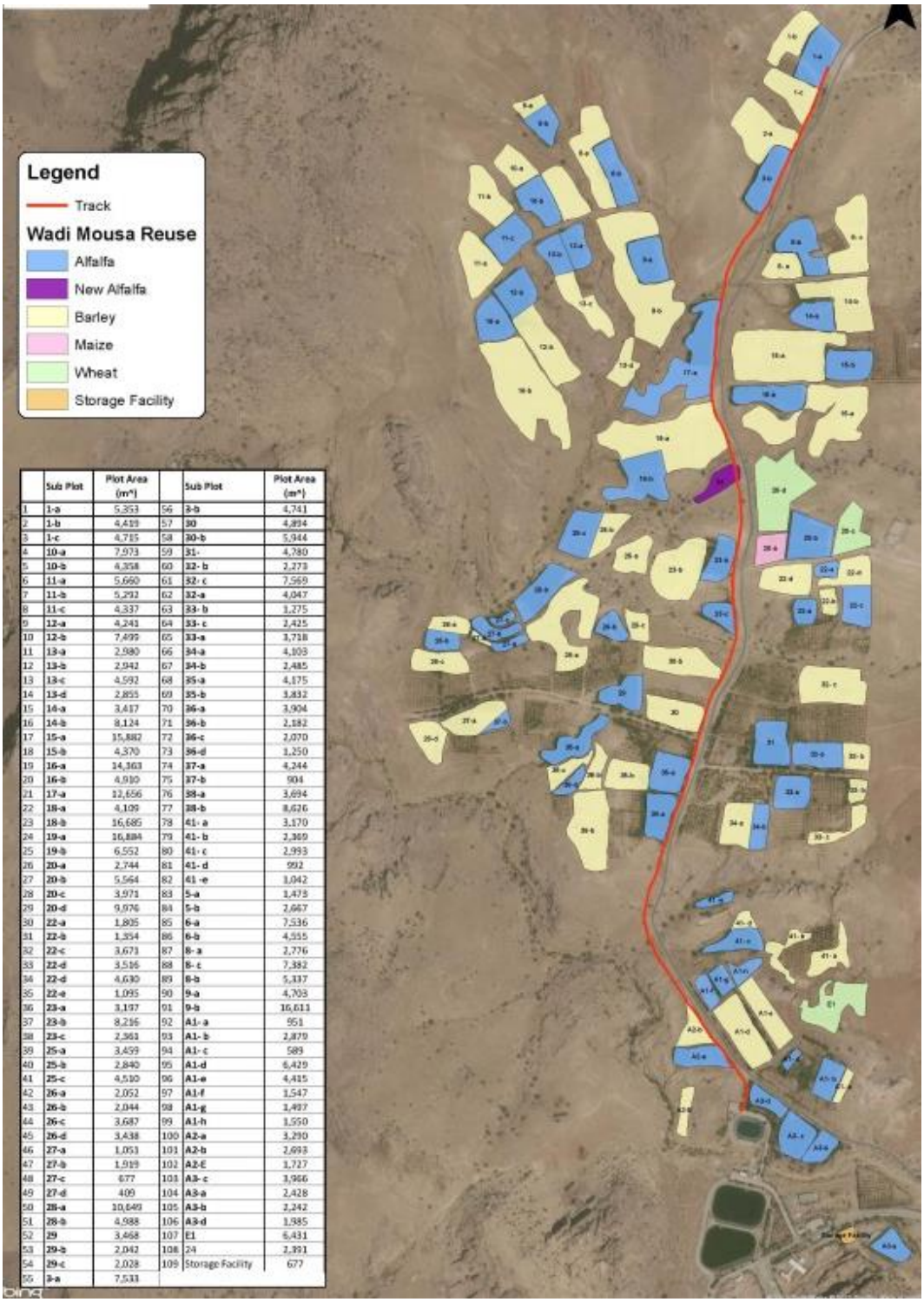
Figure 3-3. Collected land fees in 2011-2014

Membership fees and shares. According to the internal law of the WUA, membership fees are paid once (10 JD) when a new membership application is accepted. Members can also contribute to the share capital of the WUA by purchasing 250 shares (1 JD per share). Members pay for 25 shares once they are accepted as members of the WUA, while the rest of the shares can be paid as monthly installments of 5 shares. Each member is responsible to pay for the WUA debt, if any, depending on the value of his/her shares. The benefit of share-holding is that each member can get an annual profit, depending on his/her shares, if the WUA decides to distribute percentage of the annual profit (at least 20%) among its members. Both membership fees and shares are non-refundable if a member drops his membership. Note that since 2010, the WUA has not accepted new membership applications, and no new shares or fees were paid.

Maximum Revenues

The maximum revenues for the WUA were estimated, considering machinery rental fees for both alfalfa and winter crops, along with land renting fees.

Machinery rental fees. For proper management of the machines' working hours and related collection of fees, the project surveyed the actual cropping patterns at the pilot (see Figure 3-4). The WUA can collect fees according to the actual planted areas, and can then generate an efficient income. When WUA follows the full plan, it is expected that the income generated from machinery in alfalfa production will reach 30,882 JD.



	Sub Plot	Plot Area (m²)		Sub Plot	Plot Area (m²)
1	1-a	5,353	56	8-b	4,741
2	1-b	4,419	57	30	4,894
3	1-c	4,715	58	30-b	5,944
4	10-a	7,973	59	31-	4,780
5	10-b	4,358	60	32- b	2,273
6	11-a	5,660	61	32- c	7,569
7	11-b	5,292	62	32-a	4,047
8	11-c	4,337	63	33- b	1,275
9	12-a	4,241	64	33- c	2,425
10	12-b	7,499	65	33-a	1,718
11	13-a	2,980	66	34-a	4,103
12	13-b	2,942	67	34-b	2,485
13	13-c	4,592	68	35-a	4,175
14	13-d	2,855	69	35-b	3,832
15	14-a	3,417	70	36-a	3,904
16	14-b	8,124	71	36-b	2,182
17	15-a	15,882	72	36-c	2,070
18	15-b	4,370	73	36-d	1,250
19	16-a	14,363	74	37-a	4,244
20	16-b	4,910	75	37-b	904
21	17-a	12,656	76	38-a	3,694
22	18-a	4,109	77	38-b	8,626
23	18-b	16,686	78	41- a	3,170
24	19-a	16,884	79	41- b	2,369
25	19-b	6,552	80	41- c	2,993
26	20-a	2,744	81	41- d	992
27	20-b	5,564	82	41 -e	1,042
28	20-c	3,971	83	5-a	1,473
29	20-d	9,976	84	5-b	2,667
30	22-a	1,805	85	6-a	7,536
31	22-b	1,354	86	6-b	4,555
32	22-c	3,671	87	8- a	2,776
33	22-d	3,516	88	8- c	7,382
34	22-d	4,630	89	8-b	5,337
35	22-e	1,095	90	9-a	4,703
36	23-a	3,197	91	9-b	16,611
37	23-b	8,256	92	A1- a	951
38	23-c	2,361	93	A1- b	2,879
39	25-a	3,459	94	A1- c	589
40	25-b	2,840	95	A1-d	6,429
41	25-c	4,510	96	A1-e	4,415
42	26-a	2,052	97	A1-f	1,547
43	26-b	2,044	98	A1-g	1,497
44	26-c	3,687	99	A1-h	1,550
45	26-d	3,438	100	A2-a	3,290
46	27-a	1,051	101	A2-b	2,693
47	27-b	1,519	102	A2-E	1,727
48	27-c	677	103	A3- c	3,966
49	27-d	409	104	A3-a	2,428
50	28-a	10,649	105	A3-b	2,242
51	28-b	4,988	106	A3-d	1,985
52	29	3,468	107	E1	6,431
53	29-b	2,042	108	24	2,391
54	29-c	2,028	109	Storage Facility	677
55	3-a	7,533			

Figure 3-4: Wadi Mousa detailed cropping pattern (tracked using GPS in 2013).

The data presented in Table 3-8 shows maximum expected income from rental machines in alfalfa production considering the optimum alfalfa production as follows:

- Number of cuts: 9 cuts/year
- Optimum production: 200 bale/ha/cut (18 kg/bale)
- Optimum annual production: 1,800 bale/ha/year
- Maximum revenue: 29,322 JD/year

The maximum revenue for the WUA was estimated as 34,652 JD/yr. (see Table 3-8).

Table 3-8: Maximum Revenues of WUA

Machinery Renting Fees	Unit	Cutter	Mower	Baler	Plough	Thresher	Total
	JD/ha	40	40				
	JD/bale			0.5			
Optimum alfalfa production							
Cuts/year							9
Optimum production (bale/ha/cut)							200
Optimum production (bale/ha/yr)							1,800
Alfalfa (18.1 ha)	Cost (JD)	6,516	6,516	16,290			29,322
Barley (25.7 ha)	Cost (JD)				881	679	1,560
Total machinery income (JD/yr)							30,882
Eligible annual land renting fees (JD/yr)							3,770
Maximum revenue (JD/yr)							**34,652**

For winter crops, the needed work is variable, depending on the area planted and the way the farmers produce or feed their production to the local livestock. Most of the farmers do not harvest their winter crops (mainly barley), but rather they let the livestock graze directly from the farm. This means that the only agricultural practice needed is plowing the land prior to planting. Other farmers are harvesting their winter crops manually, and they use the WUA thresher to separate grains and hay. Both farmers under the pilot and outside the pilot are renting the WUA thresher. The maximum revenues from rental of the agricultural machines in producing winter crops were estimated as the maximum collected fees from plowing and threshing documented within the financial documents of the WUA. These were found as 881 JD for plowing in 2013, and 679 JD for threshing in 2014. The total maximum revenues for winter crops are therefore1,560 JD/year.

Land renting fees. it was mentioned earlier that the eligible land renting fees are 3,370JD/yr. The maximum revenue from this resource can be considered if the WUA could collect 100% of these fees in one year.

WUA expenses

The total expenses and variable costs of the WUA include operational and administrative costs and can be summarized as follows according to the financial documents of the WUA during 2010-2014:

Operational costs. These include both operational costs and the maintenance costs of the agricultural machines belonging to the WUA. These can be summarized as fuel, oil, transporting machines, licensing, insurance, baler wires and machines maintenance costs.

As shown in table 3-9, the total expenses of the WUA are mainly due to the operational and administrative costs. The operational costs ranged from 26% to 38% of the total expenses of the WUA during 2010-2014, whereas the administrative costs ranged from 62% to 74% of the total expenses of the WUA for the same period.

The machines operational costs decreased from 2010 to 2012. This is due to deterioration of most of the farms causing reduction in the planted areas and forage yield production. However, the operational costs increased again in 2013 after the rehabilitation of the pilot farms and infrastructure, resulting in increase in the planted areas and forage

yield.production, and accordingly increasing the operational load on the agricultural machines and thus the operational costs.

Table 3-9: Variable costs and total expenses (in JD) of WUA 2010-2014 as per the annual financial records

Year	2010	2011	2012	2013	2014
Operational costs					
- Machines operational costs	2,300	1,767	1,751	2,459	4,405
- Machines maintenance costs	1,551	730	2,730	407	2,424
Subtotal	3,851	2,497	4,482	2,866	6,829
Administrative and bank costs (including salaries)					
- Salaries	5,096	5,140	4,990	3,520	8,820
- Others	2,331	2,101	2,854	3,010	2,333
Subtotal	7,427	7,241	7,844	6,530	11,153
Total Expenses (Operational + Administrative)	**11,278**	**9,738**	**12,326**	**9,396**	**17,982**
Comparison Ratios					
Salaries/administrative costs %	69	71	64	54	79
Salaries/total expenses %	45	53	40	37	49
Operational costs/total expenses %	34	26	36	31	38
Administrative costs/total expenses %	66	74	64	69	62

Based on data shown in table 3-9, the machines operational and maintenance costs are high, and representing a major share of the total expenses of the WUA. This is attributed to several reasons described below.

One of the reasons for the high operational costs was, the repeated mechanical failing of the old “John Deere” tractor, where the maintenance cost of the John Deere tractor reached 2,730 JD in 2012, and 2,424 JD in 2014 forming 36-38% of the total expenses of the WUA. According to the board of the WUA, this high maintenance cost was due failure of the power steering in 2012 and hydraulic ram in 2014. As a result of this high maintenance cost, the WUA bought a new tractor in 2012 to reduce the maintenance cost and improve the agricultural services efficiency in the pilot. Consequently, the maintenance costs dropped from 2,730 in 2012 to 407 JD in 2013.

In 2014, the WUA decided to operate both tractors at the same time. This resulted in increasing the operational costs. The WUA also hired an additional driver in 2014 to operate the new tractor. As a result, the administrative costs increased significantly reaching 11,153 JD in 2014 with an increase of around 45% from 2013 adding financial pressure on the WUA..

It is important to state that considering the surveyed cropping patterns and forage yield production, the agricultural work needed at the pilot do not require operating two tractors at the same time; one tractor with proper management is enough. However, this decision has been made by the board of the WUA based on the request of the farmers hoping to improve the agricultural services in the pilot.

Another factor in the increase in operational costs was an increase in fuel prices. Fuel prices rose dramatically in 2013 and 2014. . According to the financial records of the WUA, the tractor fuel, oil and baler wires prices increased by more than 50%, which directly increased the operational costs of the machines.

It is worth noting that the rates of renting the agricultural machines have not changed since the establishment of the pilot project in 2002. Since the cost of fuel (paid for by the WUA) increased by 200% (from 240 to 470 fils from 2002 to 2014), the ratio of the income to operational cost is decreasing. Table 3-10 illustrates the percentages of the income generated from renting the machines versus the operational costs. The percentage of the generated income to the fuel cost was decreased by 50% in 2014 in comparison to 2010. Likewise, the percentage of income to the total operational costs of the machineries was decreased 50% during the same years.

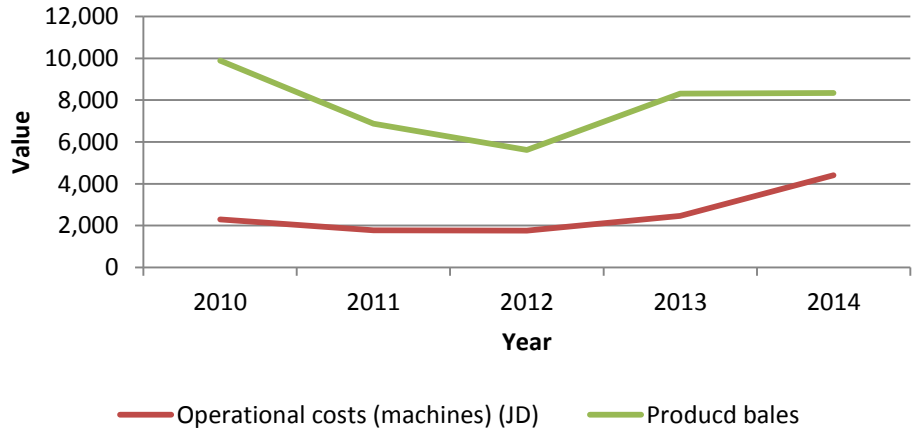
Table 3-10: Machinery income versus operational costs during 2010-2014

Year	2010	2011	2012	2013	2014
Machinery income	11,223	8,453	7,415	11,408	11,390
Operational costs	3,851	2,497	4,482	2,866	6,829
Income/operational costs	2.9	3.4	1.7	4.0	1.7
Fuel cost	1,409	1,031	1,176	1,772	2,638
Income/fuel cost	8.0	8.2	6.3	6.4	4.3

Based on the information in Table 3-10, it is evident that the WUA must increase the machines rental fees in order to cover the increase in the operational costs especially the dramatic increase in fuel prices. According to the board of the WUA, the current machinery renting prices are lower than the market prices by at least 30%. Moreover, the WUA should start renting the machines based on the actual planted area instead of the original pilot area. According to the pilot survey, the pilot area expanded by 20% for alfalfa and 35% for barley.

Documented alfalfa production. According to the collected machines renting fees recorded in the WUA financial documents, the alfalfa production during the years 2011, 2012, 2013 and 2014 were found as 6,879, 5,618, 8,306 and 8,340 bales respectively. In comparison to the machines operational costs represented earlier in Table 3-9, the alfalfa bales production was increased with the increased machines operational costs. As mentioned earlier, other forage crops could not be measured using the financial documents of the WUA, as farmers were feeding their production directly to their livestock. See Figure 3-5.

Figure 3-5. Alfalfa bales production vs machines operational costs



Administrative costs*:* Administrative costs represent the main expenses of the WUA. As shown in Table 3-9 above, they ranged from 62% to74% during 2010-2014. In 2014, the administrative costs represented the least percent of the total expenses of the other expenses, with the operating costs of the machines the highest. The main administrative expense for the WUA is the salaries, representing 54%-79% of the administrative costs, and 37%-53% of the total expenses of the WUA during 2010-204.

In 2009, the WUA used to pay the driver 200 JD, and the operator of the irrigation network 80 JD/month in addition to the 200 JD paid through the HFBD. However, in 2010, the WUA started paying 300 JD/month for the driver and 100 JD/month to the operator of the irrigation network, for a total of 5,000 JD per year. In 2014, resulting in increasing the administrative costs. Moreover, in 2014, a second driver was assigned to the second tractor, which increased the paid salaries up to 8,820 JD, with 600 JD/month for the two drivers and 100/month for the operator of the irrigation network. This resulted in significant increase in the administrative costs.).

In 2014, the WUA board were trained on financial management and agribusiness planning to better manage the pilot.. During the training, the project team clarified to the participants the importance of having efficient operational and administrative systems to contribute to the WUA sustainability., The project team emphasized that the current management trend of the WUA is threatening the financial sustainability of the WUA and the pilot. Therefore, recommendations for the board of the WUA include adopting some corrective interventions to support the financial sustainability of the WUA through increasing the income and reducing the costs. Below are some interventions proposed by the project team and discussed with the WUA:

- Hire the tractor drivers on performance contracts instead of annual fixed rate contracts; during winter season (December to March), since the machinery work is marginal and the tractor only used for plowing. This model can reduce the administrative cost significantly.
- Increase the machines rental fees in order to cover the increase in the operational costs especially the dramatic increase in fuel prices. According the board of the WUA, the current machinery renting prices are lower than the market prices by at least 30%.
- Renting the machines based on the actual planted area instead of the original pilot area. According to the pilot survey, the pilot area expanded by 20% for alfalfa and 35% for barley.

3.5.3 Farm's Expenses and Income

Each farm under the pilot is planted with both alfalfa and winter crops, mainly barley. Only the farms that were planted under Phase I include fruit trees. Field investigations revealed that the majority of the farmers are using their production of fruits (mainly olives and lemon) at their households; few of them sell any of their fruit production. In any case, fruit trees are rain-fed (meaning no irrigation requirements or cost) and require low labor. Hence, the expenses and income of the farms under the pilot were analyzed for alfalfa and winter crops only. Expenses and income for the farms were analyzed according to the financial documents and records of the WUA, and face-to-face interviews with farms.

WUA machines are used for alfalfa baling at Wadi Mousa Pilot

Documented income: On average, alfalfa is replanted under the pilot every six years, which means that the farm is ploughed once each six years. The plough fees are collected on an hourly basis, which makes them variable for the farmers. As stated earlier, the average farm area planted with alfalfa is 0.4 ha. According to the financial records, each farm requires around 1 hour for ploughing the 0.4 ha farm. Therefore, each farmer pays around 15 JD per farm planted with alfalfa. However, the cutting and mower are charged based on the area. According to Table 3-7 above, each farmer pays 16 JD for cutting, and 16 JD for the mower per farm planted with alfalfa (collecting the windrowed cut alfalfa for baling).

According to the WUA records for monthly renting fees per farm for the year 2014, the cutting fees ranged between 4-16 JD, with the number of cuts ranging between 4-8 per year per farm, with an average of 6 cuts per year. On the other hand, the average annual frequency of mowing and baling alfalfa per farm was less than the frequency of cuts by 0-40%. When not baled, alfalfa is being fed to the livestock directly after cutting, according to the farmers. In addition, farmers used to let their livestock directly graze their alfalfa even without being cut an average of twice a year (at the beginning and the end of the season). This indicates that an average of 60% of the produced alfalfa is being baled. In other words; the direct income of planting alfalfa comes from around 60% of the alfalfa production, and it is being sold as bales.

The total income from machinery documented in the WUA financial documents showed that the pilot produced 150 tons of alfalfa bales in 2014, showing an increase of 48% from that that produced in 2012 (101 tons). This means that each farmer has increased his or her annual income from alfalfa bales to 1,144 JD in 2014, in comparison with 770 JD in 2012. This is equivalent to 2,860 JD/ha of alfalfa in 2014 in comparison to 1,930 JD/ha in 2012. However, income generated from un-baled alfalfa and winter crops was not documented, as the farmers were feeding their production directly to local livestock.

The documented income from renting the agricultural machines was between 7,415 and 11,408 JD during 2010-2014 (see Table 3-10 above). Excluding the fees collected from renting machineries for barley and winter crops production, the income from renting machines for alfalfa production was documented as 10,346, 8,021, 6,918, 9,637 and 9,118 JD for the years 2010, 2011, 2012, 2013 and 2014 respectively. Considering 41 farm units, the average annual cost of renting agricultural machines for alfalfa par farm is between 169 and 252 JD (421-630 JD per ha).

Income as per farmers' interviews: The family income contains the farm and the off-farm income, whereby the farm income represents the difference between all revenues and all expenses (gross margin) from activities resulting from their own agricultural enterprise. The liquidity or availability of the cash indicates the cash requirements on a farm or family in different periods over time and the availability of cash in these periods (DOPPLER, 1998, Majdalawi 2003).

To estimate the income from the project for each beneficiary, the gross margin for different crops was estimated, considering only the cost that has been paid by the interviewed farmers. The value of the variable cost is estimated from the focus group and face-to-face interview are presented in Table 3-11.

Table 3-11: Gross margin for crops planted at the Wadi Mousa Pilot		
	Alfalfa	**Barley & wheat**
Value of output (JD/ ha)	**6,000**	**500**
- Quantity (Bales)	1,500	-
- Average price (JD/ bale)	4	-
Average variable cost (JD/ha)	**3,340**	**154**
- Water (JD/ha)	180	20
- Fertilizer (JD/ha)	200	-
- Seeds	70	45
- Pesticide (JD/ha)	200	-
- Labor (JD/ha)	660	45
- Machine rental (JD/ha)	1,840	35
- Interest of operation capital (JD/ha)	190	9
Average gross margin in JD/ha	**2,660**	**346**

The total income for beneficiaries is estimated by summation of the gross margin from each crop. The gross margin is estimated by subtracting the total cost paid at the farm level from the total revenue for each crop. In this case, the fixed cost (such as the rent of the land) is not considered in the calculation of the gross margin for each crop but rather is considered in the calculation of the total income. The average income was calculated by dividing the total income by the total number of beneficiaries. The details of the calculations reflect the improvement of living standard for about 48 families, with average farm income from the project of about 1,316 JD and total farm income for all farmers in the project with 53,960 JD per year, as described in Table 3-12.

Table 3-12: Total and average farm income for the project

	Area (ha)	**Area (ha)**	**% Change between 2009 and 2014**
Year	**2009**	**2014**	
Alfalfa	15.1	18.1	20%
Barley	20.5	27.7	35%
Total area	35.6	45.8	29%
Gross margin for the pilot			
Average gross margin - Alfalfa	40,166	48,146	20%
Average gross margin - Barley	7,093	9,584	35%
Land renting fees/Pilot	*3,770*	*3,770*	0%
Gross margin	43,489	53,960	24%
Per farm	1,061	1,316	24%

Alfalfa has proven to be an economically very successful option for the farmers. It contributes significantly to farm income. From the marketing point of view, the demand on the fodder market in Jordan exceeds supply, especially during the winter season. Because of that, all the products from the project were sold for the local community around the project area.

Also, the results show that the average income increased 24% in 2014, compared with that in 2009.

The annual cash balances are analyzed in this part of the report to provide information on the general situation of the family. Limited liquidity is a result of cash problems related to droughts and other general occurrences in the region. The analysis considers the time of the need for cash and the time of the cash availability. In this project, the liquidity was needed at the beginning of the project for establishing the farms, and USAID covered the cash needed for the investment cost (irrigation infrastructure and on-farm networks, farm preparation and seeding, machines, the WUA's building, and greenhouse). This could not be covered by the farmers.

The need for liquidity is for such things as fertilizer, pesticides, and labor. In this case, the liquidity is available for alfalfa, because each 21 days the products could be sold and the payment to cover costs for the next month is available. For olives, there is a need for money at the time when fertilizer or pesticides must be applied and at harvesting. However, not much money is required for these activities, so it could be provided by farmers themselves.

Farms' income. The main cash crop in the project is alfalfa, which is sold as green or hay. The green alfalfa is sold at JD 150/ton and the hay is sold in bales, 15kg each, at a price of JD 3-5/bale. The average alfalfa production is 300 bales/ha in winter (3 cuts), and 150-160 bales in summer (6 cuts). The farmers reported problems in marketing the alfalfa because, as they said, it is irrigated by reclaimed wastewater. When investigating this problem, it was discovered that the farmers shipped some bales of alfalfa to dairy cows farms in Shoubak, and the bales were not dried well so the inner parts were wet and rotten. The farmers were, therefore not able to sell their produce in Shoubak again.

Barley seeds are planted by the WUA and the grain yield is about 4,000kg/ha, in addition to 5,000kg/ha of barley hay. The price of barley seeds is JD 200/ton and for hay JD 150/ton.

3.6 Public Opinion

In implementing any development project, one of the most important points to be considered is the opinion of the people (local community) living in and nearby the pilot about the impact of the project. The main targeted areas were described earlier under "Demographic Conditions".

Based on the questionnaire analysis, the results show that all people know about the project and the presence of Sad Al-Hamra Association. Some 38% of the interviewees are beneficiaries of the project and 48% are members (non-beneficiaries) in the water association.

Generally, all the interviewees acknowledge that the project has succeeded in establishing the principle of using treated wastewater in irrigating fodder crops to generate income. However, farmers indicate they still face challenges in marketing their fodder due to the use of treated wastewater in irrigating the fodder. As per farmers, local customers prefer to buy forages from Wadi Araba (near to Wadi Mousa) as it is irrigated using freshwater, so they only buy the produced forage under the pilot with low rates in comparison. For example, most of the customers offer to buy the alfalfa produced at the pilot with around JD 2.5-3 per bale, while they buy alfalfa produced at Wadi Araba for JD 8-12 per bale.

More than 67% of the interviewees believe that the project improved the living standards of the beneficiaries. Also, 41% of the non-beneficiaries like to participate in the project mainly to

improve their income and living standard. Additionally, the interviewees believe that the pilot project developed the area in general in terms of landscape, environment, and infrastructure.

The interviewees also acknowledge the role of the WUA in managing the pilot although they are not completely satisfied with the board of director's management, mainly due to lack of skills in agriculture planning and business management. However, according to the majority of the interviewees, they prefer to have people from the same area and preferably representing the local families managing the pilot, than having people from outside the area.

All of the interviewees believe that the main challenge for the development and sustainability of the pilot is the limited land availability. According to the interviewees, to overcome this challenge, the WUA members discussed the possibility of sharing the land owned by the beneficiary members with the non-beneficiary members. However, discussions stopped because they created social problems in the area.

4 Sustainability of the Pilot Project

The socioeconomic study assessed the impacts of the technical assistance plan implemented at the pilot with regard to how the plan supported the water reuse activities through providing the farmers with new skills, knowledge, and network support. The study lso evaluated how the plan supported economic sustainability of the WUA and the pilot with regard to improving the efficiency and feasibility of utilizing and managing the available resources and infrastructure..

According to the project scope of work, the sustainability of the pilot is measured on the ability of both farmers and the WUA to manage the pilot properly and profitably as the owner, operator, and manager of the pilot in order to generate sustainable income to the reuse community (farmers and the WUA), thus support the economic sustainability of the pilot and promote economic growth. In addition, sustainability of the pilot is measured based on its ability to be replicated elsewhere in the Kingdom.

As explained above, the pilot resources are available (with its sustainability enhanced through improving its management) as follows:

- Land: owned by PRA which allocated the land to the farmers to grow forages under Sad Al Ahmar WUA operation and HFDB supervision
- Water: guaranteed by WAJ to be delivered to the farms all around the year according to the signed MoUs, with the water quality controlled by JS893/2006. The water resource is considered as a sustainable source in a tourist area.
- Human: the tribal configuration of the pilot area, with the land used to be known as “tribal zones” ensures adherence of the local people to the right of using the land, in addition, most of the farmers do not have another resource of income. In other words, human resources can be always considered as sustainable resource at the pilot area. There are still some issues related to tribal conflict that are being addressed by the WUA , the HFDB and the farmers.
- Livestock: which can be considered as the “consumer” of the produced forages are always available at least in Wadi Mousa, as locals used to rent them to the tourists at Petra (the historical city located in Wadi Mousa).

The overall sustainability of the pilot is directly linked to the financial sustainability of WUA. Therefore, the sustainability of the water reuse pilot project was measured on two levels: pilot level and WUA level, as described below.

4.1 Pilot Level

The sustainability of the pilot reflects if and to what extent the farmers are and will continue to benefit from the pilot now and into the future. For this assessment, only the direct benefits will be taken into consideration. This will reflect the actual socio-economic status of the farmers.

From an economic point of view, each farmer benefitted by approximately 1,316 JD per year in 2014, and this figure can increase as high as 4,900 JD per year in optimum yield production case. This is a direct benefit from selling the fodder only; the fodder used by the farmers to feed their own livestock is not included. This should be seen within the context of the annual average income per capita in Wadi Mousa, which is 3,000 JD per year (JD 250/month) (Wadi Mousa Sustainability Report, 2006).

Additionally, the pilot area expanded by 20% and 35% for the alfalfa and barley respectively from 2011 to 2014. This is a direct indication that the pilot is developing, thus increasing the direct benefits to the farmers. However, this trend is not expected to continue at Wadi Mousa due to the limited land area.

As stated above, additional benefits are being realized by duplicating the Wadi Mousa pilot effort elsewhere in the Kingdom. Upon the request of the local community in Karak Governorate, the farming community is now benefiting from new water reuse pilot project at AL-Lajjoun area 140 Km south of Amman. Elements that have been successful at Wadi Mousa are being replicated at Al-Lajjoun, particularly farmers training and support for water users' associations. Additionally, upon the request of MWI, the Wadi Mousa model is being replicated at Za'atari and Azraq refugee camps. The hosting communities will benefit from greater access to properly treated wastewater, so they could reuse it to irrigate fields and increase fodder crop yields and generate income. Such reuse would reduce subsidies on imported fodder crops and promote Jordan's economic growth.

From a technical and resources point of view, the pilot infrastructure including the agricultural machinery, irrigation system, pumping unit, and sand filters is in good condition especially after the rehabilitation works done by the WRECP. Currently, the pilot infrastructure is serving all the farms efficiently. The farmers and the WUA staff were trained to operate and maintain the pilot infrastructure to contribute to the efficiency and sustainability of the pilot infrastructure.

Additionally, reclaimed water is available and covers the demand of the pilot even after the expansion. Currently, almost all reclaimed water is used during high irrigation demand season, and excess water is discharged to Wadi when irrigation demand is low. Water delivery at the pilot was also improved. Currently, all farms are receiving adequate flow and pressure to operate their drip irrigation networks efficiently. Furthermore, the pilot's human resources from the WUA staff and farmers were well trained and became skilled farmers.

From a social point of view, according to the farmers, they realize that the pilot is their main source of income. Therefore, the farmers feel obliged to sustain it, thus sustaining their main source of income. This is reflected in the increase in fodder production and the expansion in the pilot area from 2009 to 2014. Moreover, based on the interviews, it can be concluded that the farmers and the WUA staff started to have a clearer understanding of responsibilities for the operation and maintenance of the pilot.

The main challenge facing the pilot sustainability is the limited land area. Based on the group sessions and face to face interviews with the farmers and WUA staff, the pilot's limited area creates social pressure within the local community, thus threatening the sustainability of the pilot.

As described in the previous chapters, the WUA consists of 48 beneficiaries and 72 non-beneficiary members. The beneficiaries are the members who are farming in the pilot, thus benefiting financially. Non-beneficiaries are the members who are enrolled in the WUA but are not farming in the pilot due to limited land availability, and thus not benefiting financially. The non-beneficiary members are calling for rehabilitation of extra land for them to use, or otherwise to share the available lands of the beneficiary members.

The pilot does not have the financial resources to perform such an expensive activity as rehabilitating the extra lands. This option will only be feasible with external support that is yet identified. . As for sharing the lands, it is not envisioned that the beneficiary members will agree to share their lands due to the tribal mentality of the local community. This was confirmed during the interviews with the farmers: only 38% accepted this option. This

challenge must be addressed as soon as possible to prevent escalation of the social disputes.

Based on the above, introducing alternative income generating projects such as bee keeping, livestock breeding, and a small-scale dairy factory to benefit part of the non-beneficiary members can help to ease the pressure in the short term. This can be funded through the pilot revolving fund that is operated by Sad Al Ahmar WUA, and supervised through the HFDB. However, a clear growth plan based on socioeconomic welfare of all the members of the WUA must be developed to ensure the long-term sustainability of the pilot.

4.2 WUA Level

The establishment of the WUA is considered one of the most important achievements of the pilot. The main goal of establishing the WUA is to provide a mechanism for management of the pilot by the farmers. As mentioned above, the overall sustainability of the pilot is directly linked to the financial sustainability of the WUA. Therefore, the WUA sustainability will be assessed according to its financial status.

Based on the annual financial records of the WUA, annual revenues increased 20% between 2011 and 2014, as shown in Table 4-1. This is attributed to the improved collection of the land renting fees and increased income from the machinery due to the increase in the forage yield and expansion of the farms area. In 2013, the WUA succeeded in covering the total costs and making surplus net income of 2,819 JD. However, in 2014 the total costs increased dramatically, resulting in minus net income of 3,082 JD. This is mainly because the WUA hired a project manager and an extra tractor driver to improve the pilot management and services.

Table 4-1. Cost, revenue and Net income for the water association

	2011	2012	2013	2014
Total cost	9738	12326	9396	17982
Revenue	11893	10980	14768	14900
Net income	797	-2704	2819	-3082

During the financial training, the project team emphasized that the WUA can reduce the costs and increase revenues in order to support its financial sustainability in the short term until achieving the maximum revenue model. The project team proposed and discussed several interventions with the WUA that can be applied:

- Review staff assignments and create efficiencies
- Increase the machinery rental fee, since the current machinery renting prices are lower than the market prices by at least 30%.
- Renting the machines based on the actual planted area, since the pilot planted area expanded by 20% for alfalfa and 35% for barley.
- Hire the tractor drivers on performance contracts instead of annual fixed rate contracts; during winter season (December to March), since the machinery work is marginal and the tractor only used for plowing. This is estimated to reduce the salaries cost by 30%.
- Establish the forage marketing center. This will increase the revenue of the WUA. It was agreed that 0.25 JD/bale will be collected by the WUA when farmers store their alfalfa bales in the forage marketing center and sold as bulk during the winter season through the WUA. The stored alfalfa bales have better quality; therefore it will be sold at higher prices during the winter season. This is added value for the farmers and the WUA. To do so, the board of the WUA suggested buying the produced alfalfa bales

from the farmers at fixed price and selling it as bulk with a profit of at least JD 0.25/bale. The farmers then will be secured of price fluctuation, and can face the challenge of low marketability of their products. This can encourage the farmers in increasing their production through following the best agricultural practices they were trained on, which will be reflected in an increase of their income. In addition, this alone can generate at least 2,083 JD per year based on 2014 alfalfa production.

Based on the above, it can be concluded that currently the WUA is not financially sustainable although it took solid steps towards increasing revenue. However, it is envisioned that in the short term, the WUA will become financially sustainable as the forage production yield increases and thus the machinery income increases. Moreover, the financial sustainability of the WUA will be further promoted in the short term, if the WUA applied the above mentioned interventions. The long-term success of the WUA financial status was assessed based on the maximum revenue model of the pilot which is expected to be achieved as a result of the implementation of the technical assistance plan. In the maximum revenue plan the WUA will generate 34,652 JD annually. If that happens, the revenues would exceed the costs, and the WUA would make a surplus of 16670 JD per year. Thus, the WUA would be financially sustainable even with the future investments.

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Annex A: Arabic Questionnaire

The questionnaire of data collection

"مشروع إعادة استخدام المياه والمحافظة على البيئة في وادي موسى"

01 محافظة .....

02 لواء .....

03 قرية.....

رقم الاستبانة:	
اسم جامع البيانات:	تاريخ تعبئة الاستبانة: / /20....
اسم المدقق:	تاريخ التدقيق: / /20....
اسم المفرغ:	تاريخ التفريغ: / /20....

جميع البيانات الواردة في هذه الاستبانة لأغراض المشروع فقط.
و ليست لأي غرض آخر وتعتبر سرية
بموجب قانون الإحصاءات العامة رقم ٢٤ سنة ١٩٥٠ وتعديلاته

1. <u>الشخص المستجوب:</u>

- ❒ ساكن ضمن منطقة المشروع.
- ❒ لديه أرض ضمن منطقة المشروع.
- ❒ لديه أرض قرب المشروع.
- ❒ لا يسكن او يعمل ضمن منطقة المشروع

1.1. **الاسم (اختياري) :**.....

1.2. **الوظيفة :**.....

1.3. **الديانة :**.....

1.4. **الجنس :** ☐ **ذكر** ☐ **أنثى**

1.5. **الوضع الاجتماعي:** **أعزب** ☐ **متزوج** ☐

1.6. العمر:_____

1.7. المستوى التعليمي:

- ☐ أمِّي.
- ☐ ابتدائي أو إعدادي.
- ☐ ثانوي.
- ☐ تعليم مهني و كلية مجتمع.
- ☐ جامعي
- ☐ دراسات عليا.

---

2. بيانات تاريخية عن الإقامة:

2.1. ما هو سبب إقامتك في المنطقة؟

- ☐ السكن
- ☐ العمل
- ☐ كلاهما

2.2. منذ متى وأنت تقيم \تعمل في هذا المكان؟

- ☐ أقل من خمس سنوات.
- ☐ من 5-10 سنوات.
- ☐ من 10-20 سنة.
- ☐ أكثر من 20 سنة.

2.3. إذا أتيحت لك الفرصة هل ترغب في تغيير موقع إقامتك / عملك الحالي؟

- ☐ نعم.
- ☐ لا.

2.4. إذا كانت الإجابة بنعم أذكر السبب؟

_____

3. معلومات ديمغرافية:

3.1. معلومات عن عائل الأسرة:

3.1.1. الجنس:

- ☐ ذكر
- ☐ أنثى

3.1.2. العمر _____

3.1.3. المستوى التعليمي:

- ❒ أمِّي.
- ❒ ابتدائي أو إعدادي.
- ❒ ثانوي.
- ❒ تعليم مهني و كلية مجتمع.
- ❒ جامعي
- ❒ دراسات عليا.

3.2. عدد أفراد الأسرة بما فيهم رب الأسرة:

3.2.1. العدد الكلي: _____

3.2.2. ذكور: _____

3.2.3. إناث: _____

3.2.4. ذكور أعمارهم مابين (14-60) سنة _____

3.2.5. إناث أعمارهم ما بين (14-60) سنة _____

3.2.6. ذكور أعمارهم أكثر من (60) سنة _____

3.2.7. إناث أعمارهم أكثر من (60) سنة _____

3.2.8. المستوى التعليمي لأفراد الأسرة:

- ❒ أمِّي.....
- ❒ ابتدائي أو إعدادي.....
- ❒ ثانوي.....
- ❒ تعليم مهني و كلية مجتمع.....
- ❒ جامعي.....
- ❒ دراسات عليا.....

3.3. كم عدد العاملون من الأسرة _____

3.4. إناث _____

3.4.1. طبيعة العمل (أذكر عدد الأشخاص في كل عمل):

- ❒ حكومي شخص.
- ❒ تجارة حرة شخص.
- ❒ قطاع خاص غير تجاري شخص.
- ❒ أخرى (أذكرها)

3.5. ذكور _____

3.5.1. طبيعة العمل (أذكر عدد الأشخاص في كل عمل):

- ❒ حكومي شخص.
- ❒ تجارة حرة شخص.
- ❒ قطاع خاص غير تجاري شخص.

3.6. عدد المرات التي يمرض فيها كل فرد من أفراد العائلة في العام ؟.....

3.7. عدد المرات التي تراجع فيها الطبيب في العام لكل فرد من أفراد العائلة؟.....

4. <u>معلومات عن المياه</u>

4.1. في أي يوم يتم تزويدكم في المياه للمنزل؟ .....

4.2. هل هنالك وعي حول أهمية ترشيد استهلاك المياه؟

- ❒ نعم
- ❒ لا

4.3. إذا كانت الإجابة نعم ما هي طرق ترشيد الاستهلاك للمياه (كفاءة استخدام المياه)

.....
.....
....

4.4. هل كمية المياه التي تصلكم من السلطة (البلدية) كافية؟

- ❒ نعم
- ❒ لا

4.5. هل نوعية المياه التي تصلكم ملائمة للاستعمال المنزلي (الطبخ والشرب)؟

- ❒ نعم
- ❒ لا

4.6. هل هنالك مصدر آخر لمياه الشرب ؟ اذكرها.

- ❒ نعم
- ❒ لا

4.7. إذا كانت الإجابة نعم، اذكر المصادر الأخرى

.....
..

4.8. هل يوجد نشاطات تعود بالنفع المادي، وتعتمد على وقت وصول المياه؟

- ❒ نعم
- ❒ لا

4.9. إذا كانت الإجابة نعم، فما هو النشاط .....

4.10 هل تملك قطعة أرض زراعيـــة في المنطقة؟

- ❒ نعم
- ❒ لا

.....

4.10.1 إن كانت الاجابة بنعم كيف يتم سقاية المزروعات.....

4.10.2 عدد المرات التي تروي بها ارضك..... .

4.11 هل تعلم أن الأردن يعاني من شح في المصادر المائية؟

- ❒ نعم
- ❒ لا

5. معلومات عن منافع وسلبيات تنفيذ المشروع

5.1 هل سمعت عن مشروع اعادة استخدام المياه؟

- نعم
- لا

5.2 إن كانت الإجابة بنعم فهل انت منتفع من المشروع؟

- نعم
- لا

5.3 هل سمعت عن جمعية السد الاحمر؟

- نعم
- لا

5.4 هل انت منتسب لجمعية السد الاحمر؟

- نعم
- لا

5.5 ان لم تكن منتفع بالمشروع فهل ترغب بالانتفاع؟

- نعم
- لا

5.6 إذا كانت الإجابة بنعم في السؤال السابق، ماهي الاسباب التي من اجلها ترغب في الانتفاع من المشروع: وإذا كانت الاجابة لا فلماذا

.....
.....
.....
.....

5.7 ان كنت منتفع بالمشروع فهل تقبل وجود منتفع آخر معك في الارض يشاركك في التكاليف والعائدات مقابل زيادة المساحة المخصصة للبرسيم؟

- نعم
- لا

5.8 إذا كانت الإجابة بلا في السؤال السابق، ماهي الاسباب:

.....
.....
.....
.....

5.9 ما هي الاقتراحات للموافقة على المشاركة:

.....

.....

.....

.....

5.10 باعتقادك هل يساهم هذا المشروع بزيادة فرص العمل في المنطقة ؟

- ❒ نعم
  - للمرأة
  - للرجل
  - كلاهما
- ❒ لا

5.11 باعتقادك هل يساهم المشروع بزيادة حصة الفرد من مياه االري؟

- ❒ نعم
- ❒ لا

5.12 باعتقادك هل ساهم المشروع بازدهار المنطقة (ساعد على وجود نشاطات اقتصادية جديدة) ؟

- ❒ لم يساهم
- ❒ ساهم إلى حد ما
- ❒ ساهم بشكل كبيرً
- ❒ لا اعرف

5.13 باعتقادك هل ساعد المشروع في رفع مستوى المعيشة لدى سكان المنطقة والمناطق المجاورة؟

- لم يساهم
- ساهم إلى حد ما
- ساهم بشكل كبيرً
- لا اعرف

5.14 باعتقادك كيف سيؤثر إنشاء المشروع على الناحية الجمالية للمنطقة؟

- ❒ بطريقة ايجابية
- ❒ بطريقة سلبية
- ❒ لن يساهم

5.15 ماهي المشاكل التي تعاني منها المنطقة في تزويد المياه ؟

.....
.....
..

5.16 هل تؤيد وجود مثل هذا المشروع ؟

- ❒ نعم
- ❒ لا

5.17 هل تعتقد ان هناك أي نوع من انواع الضرر عليك أثناء تنفيذ المشروع؟

- ❒ نعم (أذكره)_____
- ❒ لا

5.17.1 كيف يمكن تجنب هذا الضرر_____

5.18 هل يوجد أي أضرار أخرى بعد تنفيذ المشروع؟

- ❒ نعم
- ❒ لا

5.18.1 كيف يمكن تجنب هذا الضرر_____

5.19 ما هي أهم الفوائد والسلبيات (البيئية والاجتماعية والاقتصادية والصحية) التي قد يسببها المشروع ؟

الايجابية

.....
.....
.....
.....

السلبية

.....
.....
.....
.....
.....

5.20 ما هي مطالبكم من تنفيذ المشروع

.....
.....
.....
.....
.....

5.21 ما هي اقتراحاتك من تنفيذ المشروع

_____

Annex B: English Questionnaire

The questionnaire of data collection

Water Reuse and Environmental Conservation Project (WREC)

Wadi Mousa Reuse Pilot Site

01 Governorate ……
02 District ……
03 Village ……

Questionnaire number:	
Data surveyor:	Surveying date: / /20…
Auditor:	Auditing date: / /20…
Data entry:	Date of entry: / /20…

All data in this questionnaire can be only used by the WRECP team.
The data is considered confidential according to the General Statistics Law No. 24/2015.

1. Applicant:

- ☐ Lives in the project area
- ☐ Owns a land in the project area
- ☐ Owns a land near the project area
- ☐ Does not live or work within the project area

1.1 Name (optional) ……
1.2 Job ……
1.3 Religion ……
1.4 Sex Male ☐ Female ☐
1.5 Relationship status Single ☐ Married ☐

1.6 Age ……
1.7 Level of education:

- ☐ Illiterate
- ☐ Elementary or Middle school
- ☐ High school
- ☐ Vocational education and college
- ☐ Undergraduate
- ☐ Graduate

2. Residency:

1.8 What is the reason of your residency here?

- ☐ Work
- ☐ Residence
- ☐ Both

1.9 Since when do you work/live here?

- ☐ Less than 5 years
- ☐ 5-10 years
- ☐ 10-20 years
- ☐ Above 20 years

1.10 Will you change your work/residence place if you have the chance to?

- ☐ Yes
- ☐ No

1.11 If the answer was yes, please state the reason?

……

3. Demographic information

1.12 Family head

1.12.1 Sex:

- ☐ Male
- ☐ Female

1.12.2 Age:

1.12.3 Educational Level:

- ☐ Illiterate
- ☐ Elementary or Middle school
- ☐ High school
- ☐ Vocational education and college
- ☐ Undergraduate
- ☐ Graduate

1.13 Number of family members including the head of household:

1.13.1 Total number : ……..
1.13.2 Males : ……..
1.13.3 Females : ……..
1.13.4 Males (14-60) years : ……..
1.13.5 Females (14-60) years : ……..
1.13.6 Males above 60 years : …….
1.13.7 Females above 60 years : …….
1.13.8 Family education level : …….

Illiterate: …….
Elementary or Middle school: …….
High school: …….
Vocational education and college: …….
Undergraduate: …….
Graduate: …….

1.14 Number of employed family: …….

1.14.1 Females: …….

Job (please write the number of workers in each sector):
Governmental Number:
General trade Number:
Non-commercial private sector Number:
Others (please mention)

1.14.2 Males: ……

Job (please write the number of workers in each sector):
Governmental Number:
General trade Number:
Non-commercial private sector Number:

1.15 On average, how many times does each family member get ill annually? ……

1.16 On average, how often does each family member seek medical attention annually?
……

4. Potable water

1.17 On what day (s) of the week is potable water delivered to your household?
……..

1.18 On your opinion, is the local population aware about the importance of water conservation?

☐ Yes
☐ No

1.19 If yes, identify ways to conserve water?
……
……
……
…

1.20 Do you think that you receive sufficient quantities of potable water at your household?

☐ Yes
☐ No

1.21 Do you think that the quality of potable water, your household receive, suitable for domestic use (cooking and drinking)?

☐ Yes
☐ No

1.22 Do you use any other sources of water?

☐ Yes
☐ No

1.23 If yes, please identify them
……

1.24 Do you have any revenue-generating activities of water that depends on water delivering time?

☐ Yes
☐ No

4.9 If yes, what are they? …….....

4.10 Do you own an agricultural land in the area?

☐
☐

Yes
No

1.24.1 If yes, what methods do you use to irrigate your crops?
.....

1.24.2 How frequently do you irrigate your land?
……

4.11 Are you aware of Jordan's water scarcity?

☐ Yes
☐ No

5. Advantages and disadvantage of the Wadi Mousa Pilot

1.25 Are aware about the water reuse activities in Wadi Mousa pilot project?

☐ Yes
☐ No

1.26 If yes, are you benefiting the project?

☐ Yes
☐ No

1.27 Have you heard of Sad Al Ahmar Water Users Association (WUA)?

☐ Yes
☐ No

1.28 Are you a member of the WUA?

☐ Yes
☐ No

1.29 If you aren't benefiting from the project, do you want to benefit from it?

☐ Yes
☐ No

1.30 If your answer was yes in the previous question, what are the reasons you would like to benefit from the project, and if you answered no please explain?

…….
…….
…….
…….....

1.31 If you are benefiting from the project, do you accept sharing your alfalfa cropped area, expenses and benefits with others?

☐ Yes
☐ No

1.32 If your answer was no for the previous question, please explain.

……
……
……

1.33 What do you suggest to accept sharing your farm with others?

……
……
……
……
……

1.34 Do you think the project created new job opportunities in the area?

- ☐ Yes
  - For Women
  - For Men
  - Both
- ☐ No

1.35 In your opinion, did the project contributed to increase irrigation water shares?

- ☐ Yes
- ☐ No

1.36 In your opinion, did the project contribute to the prosperity of the area (through providing economic opportunities)?

- ☐ No, it didn't contribute at all
- ☐ It contributed a little
- ☐ It contributed a lot
- ☐ I do not know

1.37 In your opinion, did the project helped in raising the living standards for the locals and neighboring areas population?

- ☐ No, it didn't contribute at all
- ☐ It contributed a little
- ☐ It contributed a lot
- ☐ I do not know

1.38 In your opinion, how did the establishment of the project affect the surrounding areas' aesthetics?

- ☐ Positively
- ☐ Negatively
- ☐ It did not have any effect

1.39 What are the problems that the area regarding water supply?

……
……

…….

1.40 Do you support the establishment similar projects?

☐ Yes
☐ No

1.41 Do you believe that you will be negatively affected by establishing similar projects?

☐ Yes (State it) ……..
☐ No

1.41.1 How can this negative impact be avoided? ……..

1.42 Do you believe that you will be negatively affected when similar projects start operating?

☐ Yes
☐ No

1.42.1 How can this negative impact be avoided? ……..

5.19 What are the most important advantages and disadvantages (environmental, social, economic and health) that the project could cause?

Advantages

…….
…….
…….
…….....

Disadvantages

…….
…….
…….
…….....

5.20 What are your desired outcomes from water reuse projects?

…….
…….
…….
…….....

5.21 What do you suggest for water reuse projects implementation?

…….
…….
…….
…….....